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Regenerative Agriculture Infrastructure Design: The Built Environment of Food, Culture, & Soil

Jesse JW Selman
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**REGENERATIVE AGRICULTURE INFRASTRUCTURE DESIGN:
THE BUILT ENVIRONMENT OF FOOD, CULTURE, & SOIL**

A Thesis Presented

by

Jesse JW Selman

Submitted to the Graduate School of the
University of Massachusetts in partial fulfillment
of the requirements for the degree of

MASTER OF ARCHITECTURE

May 2010

Architecture + Design Program
Department of Art, Architecture and Art History

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DEDICATION

This work is dedicated to my family (Lisa, Niccolo, and Corinna).
You are my sunlight and my soil.

ACKNOWLEDGMENTS

I would like to offer thanks to the many farmers over the years that have taught me how we are connected to the earth. To the Architecture department who have patiently guided us all through the past three years. To my advisors, Steve and Kathleen, for their consistent support and invaluable feedback. To the community at Hollow's End Farm, may you continue to grow together. To Salamander Unlimited for their support of process and knowledge of the land. To Coldham & Hartman Architects and staff for your support and flexibility. To my classmates for their inspiring perseverance, design thinking, and camaraderie. To Buzz & Chris, for your generosity of ideas and spirit. To my brother and parents for making it all possible. And to my patient friends and family.

Thank you all.

ABSTRACT

REGENERATIVE AGRICULTURE INFRASTRUCTURE DESIGN: THE BUILT ENVIRONMENT OF FOOD, CULTURE, & SOIL

MAY 2010

JESSE JW SELMAN, B.A., VASSAR COLLEGE

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Directed by: Professor Kathleen Lugosch, AIA

The goal of this work is to explore the built context of our food system as a manifestation of a set of social and environmental conditions that are antithetical to the long-term health and survival of human life on this planet. The specific focus of this work is the small-scale, integrated farm. The farm is but one piece of the puzzle of how we eat and resides within the larger context of storage, distribution, economy, culture etc. Using precedents, both past and present, and through design explorations this work seeks to develop a positive course forward that will enable humanity to reconnect with its food source.

We have the potential and impetus to rebuild and to heal our local resilience, food security, and egalitarian access to fresh, healthy food. Arguably, these goals have coinciding and connected paths within other aspects of our cultural and human needs – housing, manufacturing, healthcare, etc.

The essential questions to be answered are: What does a healthy food system look like? How can this be designed to integrate into and support diverse and positive communities? What infrastructure is necessary to support the type of endeavor that creates healthy food, feeds a culture, and heals the damaged soil that is the basis of our sustenance. It is clear that industrial agriculture, the source of nearly all food consumed by Americans, is not this model. Appropriate food systems will vary by culture, climate, economy, settlement patterns, and the like. This work focuses on the condition of the Northeast region of the United States.

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CHAPTER 1

THE CONTEXT OF FOOD PRODUCTION

Introduction

This thesis explores the context and design of the built environment of food production and the necessary design principles and practices behind envisioning a food system that is both environmentally and socially sustainable. Based on the assumption, supported later in this work that the current, dominant American food system has significant negative individual, social, economic, and ecological consequences, this thesis works to move with and beyond the current energy around local and sustainable food system development to closely examine and contribute to the myriad aspects of design necessary to change. A core concept to this mission is to recognize the need for a regenerative or healing approach prior to reaching the goal of sustainability.

To envision a new food system, one with environmental and social justice priorities, in a way that creates effective, durable, and necessary change requires a transformational design paradigm and skill set. Such a design methodology requires a broad and intertwined understanding and impact across the total production/infrastructure chain, soil to table. This design approach must look at system level thinking and practice, as well as the actualities of physical space and objects of interaction. As we work to envision a new and sustainable food system, humanity will engage the re-design of simple farm tools, farm based infrastructure, farming systems, regional processing/distribution hubs, the ways

and means of transportation, business and ownership models, community-based commerce, and likely our relationship to food as a whole.

The architecture of such a system spans multiple disciplines; engages at many different levels; is influenced by corporations, governments, interest groups, communities, and individuals; and affects a broad range of ecologies – environmental, social, and economic.

Figure 1 shows the interconnected relationship of humans to their caloric and nutrient sustenance as defined by Buzz Ferver. For this system to work, each node of the triangle must thrive.

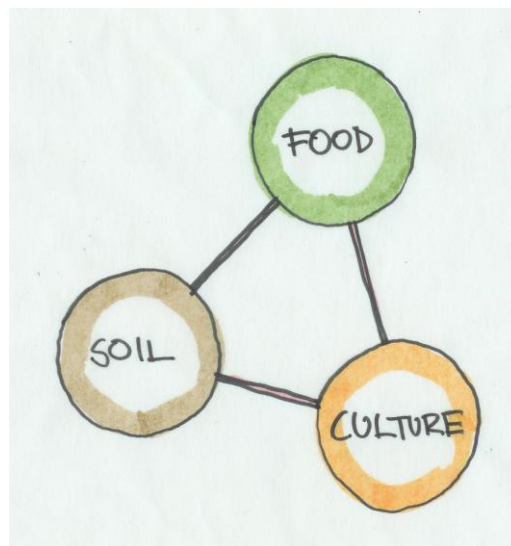


Figure 1: Buzz Ferver's Triangle of Human Food Ecology

Currently in America, food culture and soil have been damaged. While it is possible to produce and consume food in the way Americans do, the repercussions have been disastrous.

Food that is both unhealthy for the eater as well as the environment. "Four of the top 10 killers in America today are chronic diseases linked to diet: heart disease,

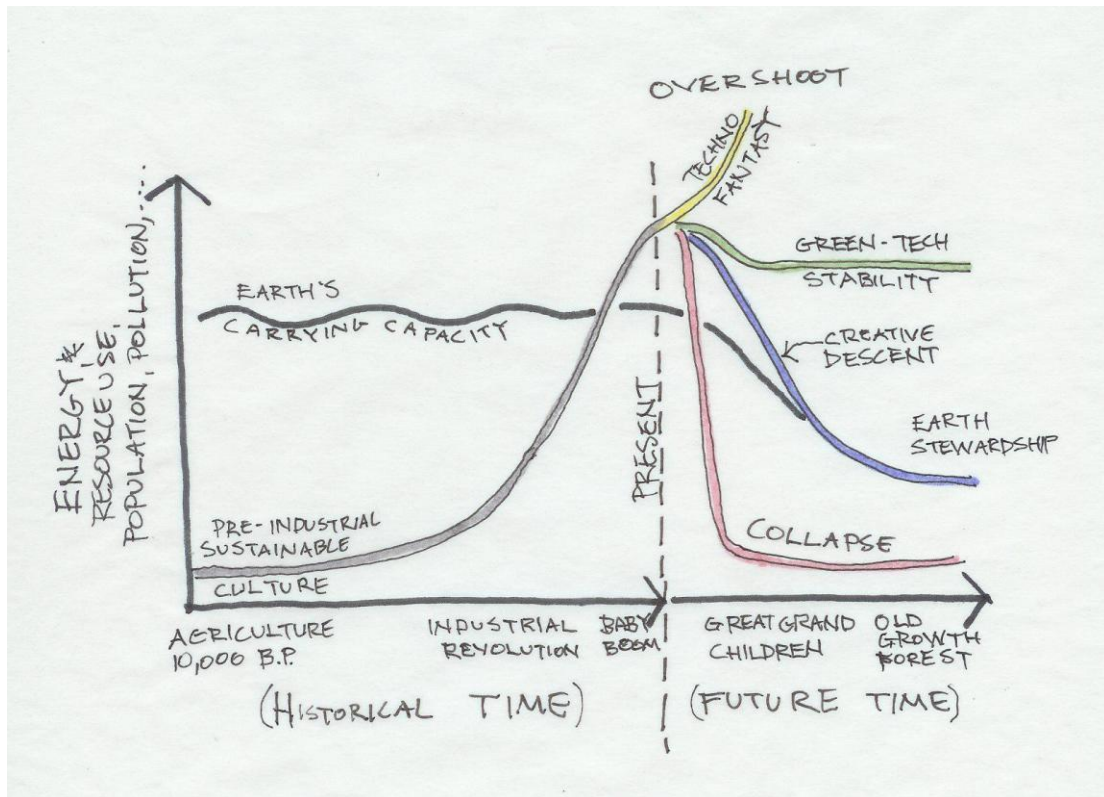
stroke, Type 2 diabetes and cancer.”¹ “29,100 calories: estimated fossil fuel calories required to produce one order of Outback Steakhouse Aussie Cheese Fries”²

Soil, the medium for growing food, has been eroded and contaminated.

The great plains have lost 30% of the soil to erosion³ coupled with the addition of chemical farming resulting in a 8,000 square mile “dead zone” in the Gulf of Mexico.

Culture has abandoned its connection to the source, healthful diversity of, and respect for food.⁴ “Americans choose to eat less than .25% of the known edible food on the planet”⁵

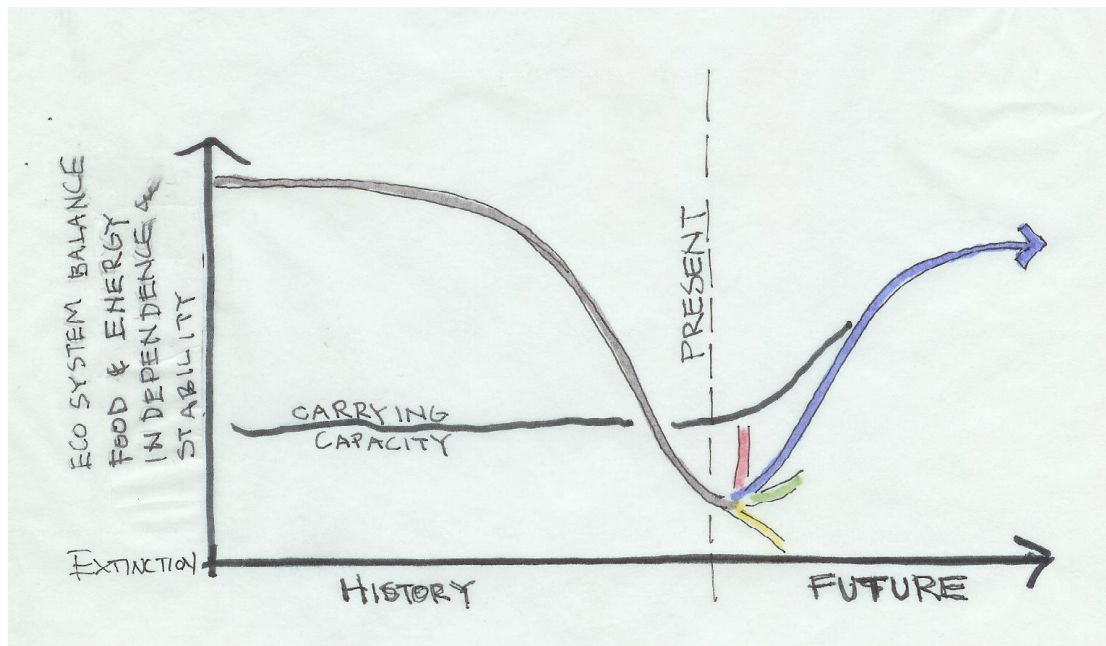
The goal of this work is to both convey a sense of urgency while also illuminating an important opportunity. There is much evidence that the lifestyle the western world enjoys cannot be maintained indefinitely. Humans are currently consuming more than the carrying capacity of the earth, which is putting great strain on our environments including our own social structures.⁶ Economist, Chris Martenson states, “I think the next twenty years are going to look very different from the last twenty years.”⁷ There are many ways to consider and prepare for this future--fear, denial, nihilism, optimism.⁸ This process can be exciting and beautiful. It can also bring on the common struggle that is the backbone of community.



**Figure 2: Graphic Representation of Urgency
(After David Holmgren 2005)⁹**

Figure 2 shows a number of scenarios of how humanity will handle the challenges of growth within a limited system. The essential premise is that when growth exceeds the carrying capacity of a system, there is a collapse. The lines to the right of the “present” day on the x-axis show a number of scenarios based on various world views. The techno fantasy imagines some way to use technology to maintain our current growth rate, which scientists have shown will create a system collapse.¹⁰ Green Tech Stability will also push down the carrying capacity and likely result in collapse. Permaculture author David Holmgren offers the path of controlled reductions to the growth model seen in blue.

This graph, as are many of this topic, is presented to portray a dire picture. However, if we flip the y-axis, the picture becomes slightly different. Instead of a plummet into despair, we can follow a path that works away from fossil fuel dependence, pollution, and the associated scarcity, war and decline in human health towards a world of energy independence, equality, and global access to quality of life. (Figure 3)



**Figure 3: Graphic Representation of Opportunity
(After Lisa Dipiano)**

Be Joyful, Though You Have Considered All The Facts . . .The Facts

In one of his many poems on the topic of farming, culture, food justice, etc., Wendell Berry States, "Be Joyful, though you have considered all the facts."¹¹ Humans are facing crisis. Environmental degradation, climate change, and geopolitical strife top the list. We are, as a species, multiplying rapidly and rapidly multiplying our effect on our environment. Some of the most devastating

impacts on our environment are made by the locations and modes of food production, simultaneously endangering the future of safe food. According to Dave Jacke,

Ecologically, the toll of modern agriculture includes:

- Lost topsoil (some say topsoil is the largest U.S. export by weight);
- Lost genetic diversity in seed crops;
- Depleted water resources
- Chemical contamination (of water, soils, food, workers, and wildlife);
- Increasingly pesticide-resistant “pests” and “weeds”;
- And ten or more calories of energy expended for every calorie of food produced.¹²

In a footnote, he alludes to studies that put the last figure at 20:1. Our limited connection to this mode of production allows it to continue. As with any system, without feedback loops that quickly show us the effects of our actions in a way that directly affect us, it is difficult to adjust our actions to create positive or healthful outcomes. In a large, complex food system we rely on government and corporate oversight. The FDA and USDA are not protecting us from many of the threats of food safety. Of the 226,377 establishments that are registered to export food to the US,¹³ only 200 on-site inspections of these establishments were conducted by the FDA last year.¹⁴ The industrial facilities that process the majority of our food are closed to consumers. We are out of the loop when it comes to our sustenance.

This was not always the case. For hundreds of thousands of years, Homo sapiens lived a transient existence, following the seasons for available

sustenance. With the advent of surplus, the past 10,000 years saw increasingly sedentary modes of food production (agriculture), and a built environment that supported them—simple permanent housing for people, crops, and animals. In just the past fifty years, food production and its supportive infrastructure have followed the path of industrial globalization, transforming the farming environment with stunning suddenness. New technologies of transportation, information-sharing, and production have created a world in which people and their food are moving greater distances than ever before.¹⁵ Global food networks are supported by factory farms, warehouses, processing and packing facilities, and a fuel-inefficient shipping infrastructure. All of these approaches to food production alienate the consumer and have been shown to cause a decline in nutrition, worker safety, and humane conditions. These facilities are designed to be failsafe, but they are not safe to fail. Figures 4 and 5 show the inhuman scale as well as the potential for dramatic system breakdown.



Figure 4: Non-Resilient System After Hurricane Floyd
(<http://www.erh.noaa.gov/mhx/Floyd/Impacts.php>)

There are significant risks in a situation, in which humans are remote from their food sources; existing within an infrastructure that does not allow for the awareness of food production and its antithetical relation to human scale. When E-Coli outbreaks occur, millions are effected. In smaller scaled operations an outbreak would only effect a few hundred at the most.

The first great call to the aid of the environment and humanity against corporate pollution came in the early 60s with Rachel Carson's *Silent Spring*. Post WWII chemical-based technologies in food production promised to feed the world. They gave us DDT. The same companies that Carson exposed, as well as

others, are continuing to pollute our world and risk our futures. These threats are verging on the point of no return; many say we are past it.

Author Bill McKibben offered staggering statistics on the matter in his keynote address to the Orion Society.

The average bite of food travels about 1,500 miles to get to your lips in this country. If you go to the supermarket and buy supermarket organic food, that travels further: more than 2,000 miles on average to get to your plate. The cost of that is amazing. If you go to the supermarket and buy a head of lettuce from California, to get one calorie of it back here took about 36 calories of fossil energy to grow it and to transport it.¹⁶

The popular dialogue on the subject ranges from the dire warnings of James Howard Kunstler and Lester Brown to the compelling arguments and tactics of Wendell Berry and David Orr to regain the knowledge of our most basic necessities and appropriately usher that knowledge into the current world.

Kunstler describes the situation in his book, The Long Emergency

The salient fact about life in the decades ahead is that it will become increasingly and intensely local and smaller in scale. It will do so steadily and by degrees as the amount of available cheap energy decreases and the global contest for it becomes more intense. The scale of all human enterprises will contract with the energy supply. We will be compelled by the circumstances of the Long Emergency to conduct the activities of daily life on a smaller scale, whether we like it or not, and the only intelligent course of action is to prepare for it. The downscaling of America is the single most important task facing the American people. As energy supplies decline, the complexity of human enterprise will also decline in all fields, and the most technologically complex systems will be ones most subject to dysfunction and collapse – including national and state governments. Complex systems based on far flung resource supply chains and long-range transport will be especially vulnerable. Producing food will become a problem of supreme urgency.

The U.S. economy of the decades to come will center on farming, not high-tech, or “information,” or “services”, or space travel, or tourism, or finance. All other activities will be secondary to food production, which will require much more human labor. . . .¹⁷

He continues on to describe the dependence of our food systems on cheap fuel for “machines, irrigation, ...trucking, ...herbicides, ...pesticides, ...fertilizers,.”¹⁸

Ultimately, he concludes that “Americans will be compelled to radically reorganize the way food is produced, or starve.”¹⁹

How widespread and problematic is this current trend in factory farming?

“Ninety-Nine percent of all land animals eaten or used to produce milk and eggs in the United States are factory farmed.”²⁰ “Animal Agriculture ...is the number one cause of climate change.”²¹ The current built environment of food is no longer at a human scale. Chickens are raised in warehouses with millions of other birds; a single dairy can milk 13,000 cows three times a day; multi-thousand acre mono-crop farms are sprayed with chemicals by unmanned GPS controlled tractors; the list goes on. The architecture of industrial farming is comprised of giant laboratories, massive grain elevators, expanses of concrete feedlots, processing factories, and a chemical landscape. Food is a commodity to be traded for profit, soil is the medium for creating short-term profit, and culture is driven by making cheap food.



Figure 5: Flooded Hog Facility
(Used by permission from Food & Water Watch)

It was not always this way. In 1930, the average flock size in the US was 23 birds.²² Farming “in 1940 produced 2.3 calories of food energy for every calorie of fossil-fuel energy it used.”²³ With 18,467 new small farms counted in the last agricultural census²⁴, the tides may be shifting. The situation has given rise to a strong, small, and growing movement to recapture the local production of food. 7 million new gardens were planted in the US in 2009.²⁵ According to the USDA, there are 4,685 farmers markets nationwide²⁶, and growing.

Critical to this movement are many bodies of knowledge and strategies. Approaches range from historical form (10,000 years of lessons embodied in traditional forms of production) to current sustainable design (fifty years of form reacting intelligently to corporate-industrial trends). We will examine the formal and practical manifestation of these approaches in Chapter 3.

While there are critical lessons from the practices of the past, the next generation of farm infrastructure will face the challenges of a planet beyond capacity and require new creative solutions.

Current Context

Virtually every colonist was a farmer. According to the US census, in 1850 45% of American males were farmers. This does not even include farm laborers that peaked at nearly 20% of the population in 1870. By the year 2000 the number of farmers had dropped down to 0.4%. In the same time period the percentage of women farmers dropped 0.3% - 0.07%.²⁷ We have worked so hard to remove ourselves from the farm. What had modern agriculture achieved by the

mid twentieth century just before WWII? According to Sir Albert Howard, whose research was based on traditionally sustainable cultures of the east:

Since the Industrial Revolution the processes of growth have been speeded up to produce food and raw materials needed by the population and the factory. Nothing effective has been done to replace the loss of fertility involved in this vast increase in crop and animal production. The consequences have been disastrous. Agriculture has become unbalanced: the land is in revolt: diseases of all kinds are on the increase: in many parts of the world Nature is removing the worn-out soil by means of erosion.²⁸

Because the question we are examining is how to organize a food production system that connects food, culture, and soil, we must understand the importance of soil as both a driving force and a direct result of culture. A culture of corporate profit-driven growth capitalism will have a very different treatment of soil and food than one based on human rights, health, and species survival. Howard defines an approach to soil health based on cultural practices that support this goal.

Farming must include animals, be mixed and diverse, no soil can be left exposed, and we must build humus. The biological activity of the soil web of life is essential to our existence -- “on the efficiency of this mycorrhizal association the health and well-being of mankind must depend.”²⁹ He suggests a profound relationship between man, fungi, and micro-organism—a true ecologist.

Howard rejects the notion that chemical farming will be anything but a disaster. “The best way to increase the intelligence of scientists would be to reduce their numbers.”³⁰ He clearly makes the link between human health and soil health. “I venture to conclude this book with the forecast that nearly half the illnesses of mankind will disappear once our food supplies are raised from fertile soil and consumed in fresh condition.”³¹ He even gives estimates of the rising

cost of healthcare due to trends in farming. These sentiments have seen a recent resurgence in practice and theory.

On a practical level, this necessitates a type of agriculture based on small-diversified endeavors. The scale of these endeavors, long-term ownership or community connection, and appropriate technologies all define the character of the built environment of food production. Howard demonstrates the importance of balancing growth and decay. While difficult, this can be monitored and achieved on small farms within regional food systems. It has been shown to be impossible to achieve this at the level of global industrial agriculture. Howard's work provides a basic framework for the design work in Chapter 3 including scale and farm systems thinking.

Much of the design thinking in this piece is based on the notion that we are not necessarily making change, but preparing ourselves for inevitable change. The best way to do this is through the creation of a resilient system which includes farms and farm infrastructure.

Why food and farms as a first priority? The growing Transition Town movement puts food as a top priority for the dwindling land base of the UK. In discussing land use, Rob Hopkins states, "Food first, then medicinal plants and materials, then fabric crops, then building materials, then down near the bottom (just slightly above building supercasinos) biofuels, if--and it's a big if--there is any land left."³²

Resilience comes from diversity, modularity, and tightness of feedbacks.³³

It “is the capacity of a system to absorb disturbance and reorganize while undergoing change, so as to still retain the same function, structure, identity and feedbacks.”³⁴ This cannot be replicated on a global corporate scale. Chapter 3 examines how to manifest this in the built form.

Creating a vision for a resilient and regenerative society can easily be clouded by use of these concepts to create saleable products. As ‘organic’ and ‘green’ products become increasingly popular both have become co-opted by corporate interests, losing the original intent and replacing it with strong profits from a growing “environmentally conscious” market. There has been a quick response by many to clarify what sustainable really is. Over the past decade, Michael Pollan has been this voice for agriculture. He brings to the general public what many sustainable producers are dedicated to--the idea that organic is only one part of the equation. Mass-produced, processed food can still be “organic.” America continues to learn this the hard way with the recent bagged spinach E-Coli outbreak or Hexane in baby formula, veggie burgers, and other “healthy” soy products.

In his essay entitled *Farmer in Chief*, written October 2008 to the president elect, Pollan beseeches the new leader to adopt a sensible food policy. Pollan makes a compelling case that fixing the food system will solve the looming energy, health-care, and geo-political crises which manifest in foreign and trade policies, food riots, fallen governments, loss of farmers, overnutrition in the first world are now contributing to undernutrition in the third, and terrorists. Despite this he believes that “reform of the food system may actually be possible.”³⁵

It must be recognized that the current food system — characterized by monocultures of corn and soy in the field and cheap calories of fat, sugar and feedlot meat on the table — is not simply the product of the free market. Rather, it is the product of a specific set of government policies that sponsored a shift from solar (and human) energy on the farm to fossil-fuel energy.³⁶

He theorizes that with the addition of millions of new farmers and the appropriate legislation we can essentially reconnect food, soil, and culture and solve or mitigate the looming crises we face. His specific strategies are eloquently summarized in the following actions.

- I. Resolarizing the American Farm
- II. Reregionalizing the Food System
- III. Rebuilding America's Food Culture

Pollan's popularly understood outlined priorities for revolutionizing America's food system, provides a framework to think about the specifics of these design practices. The three priorities represent key focus areas within a holistic view of the production, processing, transportation, procurement, and consumption of food: re-solarizing farms, re-regionalizing food systems, and re-building our culture around food. Within each of these three focus areas exist the need for design practices and allow for an intertwined set of design categories: Food System Design, Food Interaction Design, and Regenerative Agriculture Infrastructure Design.

Food System Design is the system design and regional planning associated with linking production areas with consumers in efficient, creative, sustainable, and economically inclusive ways. Additionally, it is the design of infrastructure components and modes of operation involved in such a food system (aggregation points, packing houses, processing operations, slaughter houses, storage systems, etc.)

Food Interaction Design concerns the built environment associated with our interaction with food--shopping, cooking eating, disposal, etc. It is design that builds kitchens that promote the love of cooking and the use of fresh, whole ingredients. Dining rooms (and even tables) that promote sitting and eating and talking and staying. Houses that have root cellars and pantries. Marketplaces that are social, informative, and fair.

Regenerative Agriculture Infrastructure Design: This is the starting point of the healing process of our farms. This process will create a farm that does not simply sustain itself, rather, it will restore itself. Soil health and productive capacity will lead to a positive role in the community defined not by growth but stability and interconnectedness to an emerging network of agricultural economies. The design of the farm will be the focus of the Chapter 3 of this work and the design process it reveals.

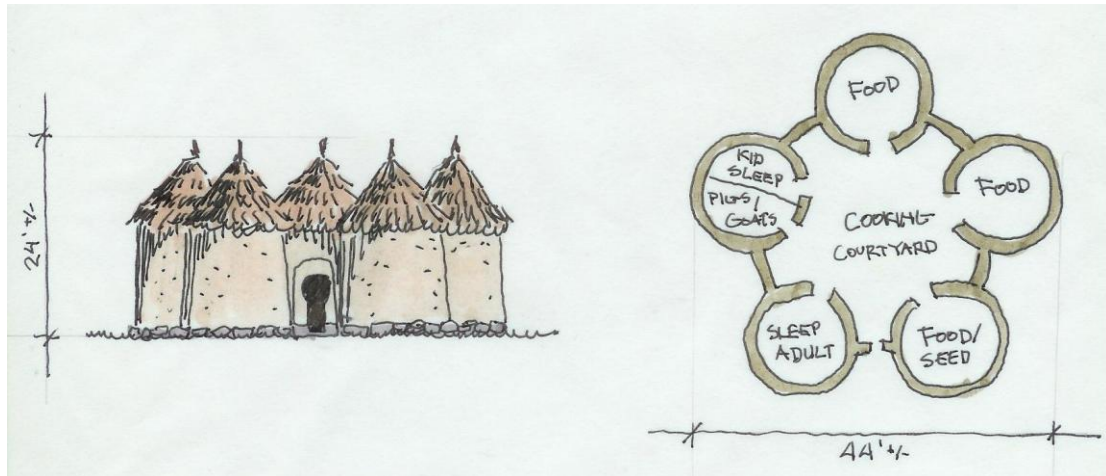
The revitalization of one farm begins with the investment in place--the creation of a local system of food production. As we face economic insecurity, localizing food production would have reaching positive effects. Primarily, money stays in community instead of going to a corporate headquarters. A study in Vermont found "if local consumers 'substituted 10% of the food we import, it would result in \$376 million in new economic output, including \$69 million in personal earnings from 3,616 new jobs."³⁷ Ten percent is not a dramatic number, but it would be a revolutionary catalyst for change.

To reinvigorate the agriculture of the northeast will require investment, repopulation, and an understanding of the place to be farmed. From the specific soil to the regional landscape, to the structures, every place has a story. This is the story of food, culture, and soil and began before history.

Pre-Historic Context

The original architecture of human beings was a direct result of our agriculture. For millions of years humans were transient following the seasonal flow of game, water, and gathered foods. Merely 10,000 years ago (less than 0.5% of human existence) marks the beginnings of agriculture as we know it – seeds planted, animals kept, harvests gathered and stored instead of followed. 6,000 years ago few humans were past a typical mode of subsistence farming and the lifestyle it supported--semi-permanent dwellings.³⁸ Throughout each chapter of humanity, built form was associated with survival: shelter, access to food and water, and the ability to store and protect these essentials.

The architectural manifestation of a world where food and culture are connected is a stark contrast to the modern American dwelling. A current example of the semi-permanent dwelling type is the Mesakin Quisar Cluster Dwellings of the Nuba People of the Sudan. They are a Hoe-Peasant subsistence society who cultivate durra – a maize-like millet.³⁹ Figure 6 is representation of their typical housing pattern.



**Figure 6: Food-Integrated Dwelling
(After Schoenauer, 2000)**

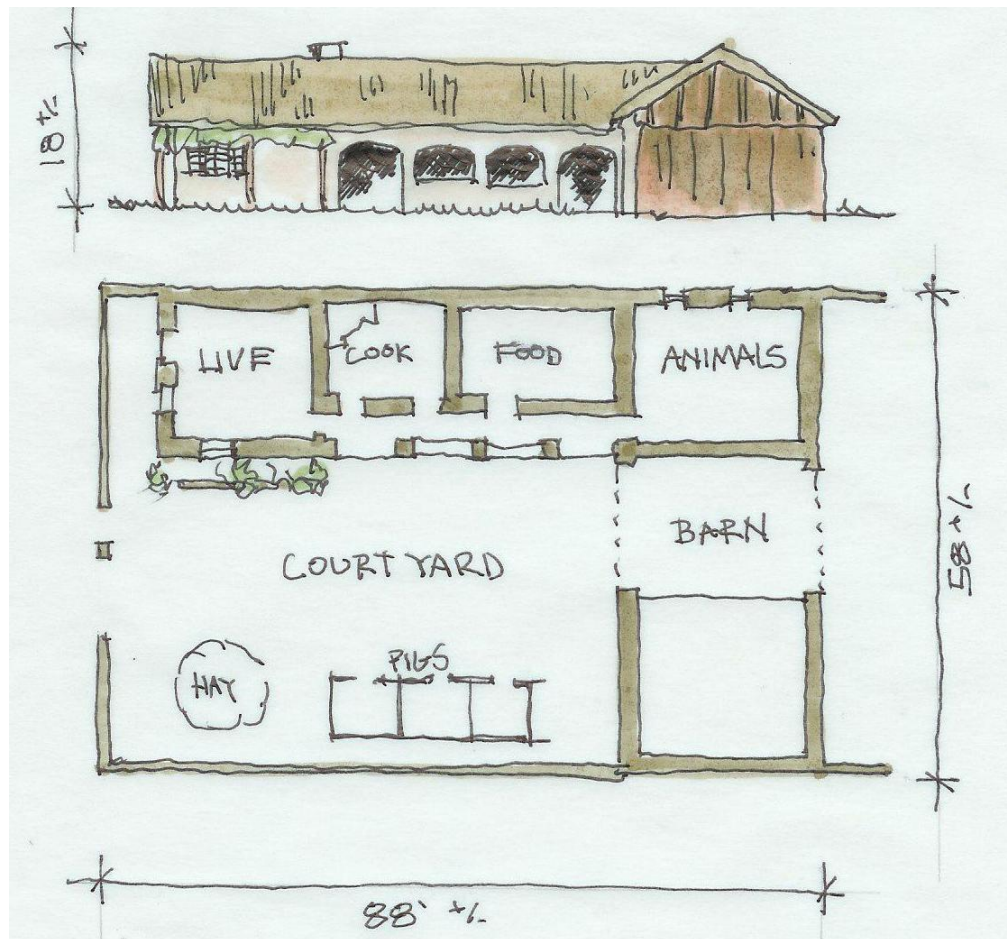
Note the separation, or lack of separation, between the function of housing and the function of food production and storage. Early architectural forms are agricultural forms as well.

This “house” or structure is designed to store food and seed and house people and their animals. Limited to local materials: the adobe walls and thatched roof are built to last only as long as soil is productive in a particular area. After five to ten years, the dwelling is abandoned and soil left to heal. Climatically driven passive design is employed with thick walls whose thermal mass to temper the extreme diurnal temperature fluctuations of the region. The low heat capacity of the thatched roof does not overheat in the sun, and is naturally vented. The keyhole door appears to be a handsome embellishment, but is actually a function of the large overhead loads carried into the structure.

The trend continues despite a specialization of spaces--the pigs and goats no longer share a room with the kids, though the animals have remained in the same structure as humans up to the present day in Germany and Switzerland.⁴⁰

Other changes, such as resource availability, technology, and climate drive these examples of early architecture. However, the essential program is unchanged--a simple system to manage food and shelter alongside cultures of work and play, family and community.

Figure 7 depicts a traditional Hungarian farmstead where food and culture are wedded in architecture.



**Figure 7: Hungarian Farmstead
(After Schoenauer, 2000)**

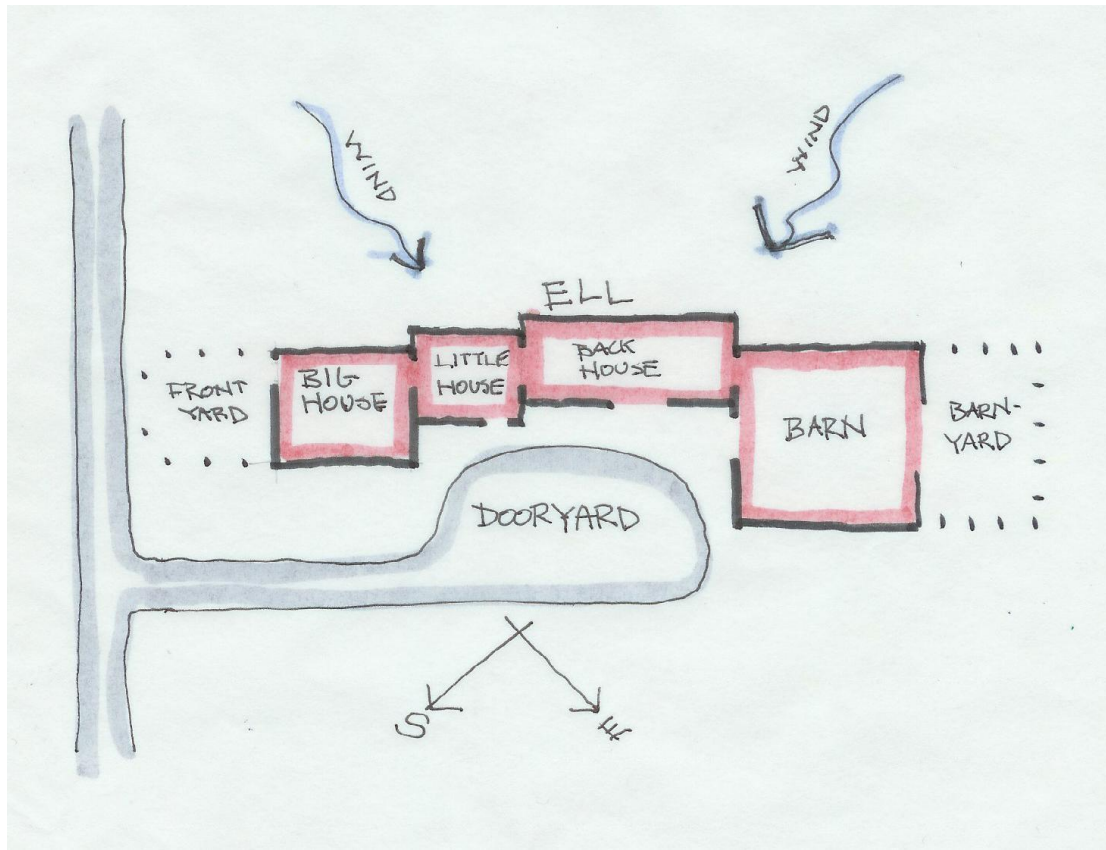
These traditions continued to the United States. The image below depicts a house and barn combined into one structure built in 1860 in Missouri by a German immigrant. It is also elegantly melded into the landscape, while

maintaining a practical form driven by climate and material resources. Use of topography is manifested in the design shown in Chapter 3.



Figure 8: House-Barn (Einhaus)
(After Vlach, 2003)

Below is a traditional New England farm building pattern – “big house, little house, back house barn.”⁴¹ Getting more complex, but very similar is the idea of home integrated into a model of production beyond the family or village--cottage industry.



**Figure 9: Dooryard Diagram
(After Thomas Hubka, 1984)**

In 10,000 years the change in the architecture of food production has not been dramatic. It was always connected to home and the craft of a handmade world. As food departed from home, so did its influence on form. Today, as pendulum has swung food away from home, there is a unique challenge to incorporate housing into food production systems--both to connect the nutrient flow as well as the culture. The American family farm relies on large families dedicated to the land. This is difficult to create. As we will see in Chapter 3, the incorporation of communities and networks of farms are critical to the success of the small farm.

Regional Context: The Historic Architecture of Food Production in Southern New Hampshire

The story of non-coastal, non-urban New England is fairly consistent. Woven into it is a tale of food infrastructure that wanders from a wooden spear to the frozen food aisle in the supermarket. The faces of soil, food, and culture evolved throughout the past 500 generations of habitation. Ironically, the landscape the current residents have inherited is not dramatically different than the early period of post glacial reforestation; an increasingly hungry population and a soil in need of repair.

Ten thousand years ago, soon after the last ice age the area was vegetated with low brush and grasses with scarce opportunities for human sustenance. Southern New Hampshire was the southern edge of Abanaki country. In 1600 the population in the area that is now New Hampshire was 12,000. In the same tragic story that is our legacy throughout the world, the Abenaki population dropped to 100 in the next 190 years.⁴²

Prior to European settlement, there was a major cultural change with repercussions on soil, food, and the built environment. 3,000 years ago the Abanaki in southern New Hampshire began to farm.⁴³ Accompanied by changes in climate and technology the lifestyle shifted from one of traditional hunter-gatherer to year-round villagers. Bent wood and bark sheathed longhouses were built and housed multiple families in winter. Storage pits and the growing of excess crops (corn, beans, squash, and tobacco) also allowed for a semi-permanent existence and the associated changes to the environment.

As we follow this place through time, as with any place, landscape, artifice, and culture develop in relation to environmental changes. The Abenaki world, a product of the local conditions, available resources, and native economies and practices, gave way to the settlement patterns of the Europeans. Gilsom was settled and incorporated in the mid 1700s. It met the same fate of the rest of New England, which was virtually deforested and covered in sheep by the 1800s. The ovigenic landscape that resulted eroded soils and has been consistently abandoned as larger farms in a national marketplace emerged further south and west.

During the pioneer days “everyone tilled the soil, and every farmer was a ‘Jack of all trades.’”⁴⁴ They fulfilled their needs with the materials at hand and a limited connection to commercial markets, cash, or the goods therein available. Like the Abenaki, homes were made entirely of wood along with the other structures on the homestead. The purpose of the entire infrastructure was to support food production and to provide protection to the family, animals, and stored food.

A lifestyle intimately connected to sustenance saw the prolific creation of a world made of wood, stone, and iron. Barns, coops, storage of all kinds, gardens, drying space, animal shelters, maintenance shop, spring house, well, corn crib, shed, drive through, turnip cellar, root cellar, sugar house, smoke house, wagon shed, butchering shed, ice house, fences, walls, bridges, and a vast collection of clever implements for carrying out the business of survival. For the most part this was a world made by hand, limited by skill and material conditions.



**Figure 10: Hollow's End Farm: Late 1800s
(Public Domain: Courtesy of Salamander Unlimited)**

From 1815 to 1915, the internal economy of this country developed a network robust enough to support the expansion and specialization of farms. The diverse homestead farm gave way to the larger farms with a few products that traveled in raw form from farm to mills and slaughterhouses. "Instead of each man's attempting to supply all his own needs from his own labor, the farmers were selling wool and buying clothing, selling hides and buying shoes and harnesses, and selling wheat and buying flour."⁴⁵ With the division of labor the "country

carpenter” emerged facilitating the investment in large farm buildings. Hired labor was available as well.

The ready sale for surplus products caused most farmers to practice in their farm building program the general slogan of the time, ‘bigger and better.’ Size was emphasized at the expense of service. Little thought was given to the influence of the structure on the quality of the products marketed, on the health of animals housed, or on the efficient use of the farmer’s time.⁴⁶

In this description from a 1946 series on agriculture, based on university lectures, the author goes on to describe the modern era of farming and the necessity to industrialize in order to compete with the factories. Indeed, the massive body of literature devoted to agriculture from extension agencies and land grant universities is geared towards industrial economics, large scale, and corporate technological dominance. The new scale of agriculture never came to rural New England in a significant way. New England’s peak agricultural days still saw many small farms serving a market such as Boston. The topography, poor soils, and cheap fuel allowed cheap food from far away to fill supermarkets and from the end of World War II to the present, family farms in the Northeast have been in steady decline. The material conditions, especially the availability of cheap fuel and the automobile-based economy, has eliminated the perceived need for a thriving network of small town food resources supported by a regional marketplace.

Vernacular Influence on Theory and Design⁴⁷

It is particularly relevant to examine the vernacular form of agricultural enterprises in the northeast because they existed within a culture that saw broad fluxuations between abundance and scarcity in a similar climatic context. The

early American farm was the manifestation of a sophisticated understanding of lighting and microclimates. They skillfully used landscape to control climate and intelligently place buildings. Early morning sun could burn off fog and mist around the house, while barns tended to receive afternoon light to extend the day. In cold spots trees would protect from north winds and in hot spots they provided shade.

Barns and structures could be used to provide protection as well, though animal barns were also put to the windward to keep smells and disease away from the house. Special attention was paid to fresh water accessible but elevated above farm activities that could contaminate it. Some farms would even locate on a north slope to be close to a fine spring. Porches could be made to be warm and sunny in the winter and shady and breezy in the summer.

Technology had an interesting role in farm building traditions. Not until the advent of screens and tin and asphalt roofs was the use of shade trees employed to cool buildings. This is because the ill effects of rotting wood roofs and insect habitat were less desirable than the shade that caused them. Many of our building strategies today would not work without access to certain technologies or fuels.

Americans faced their first fuel crisis in the winter of 1637-38. Bostonians ran out of wood--their only fuel source. The country farm in the 18th century used 15-20 cords of wood each winter to cook, process food, and space heat. That requires 10 acres of forest per year and is equivalent to over 2500 gallons of oil. A similar situation happened in the 1800s in Cape Cod, which was a barren

landscape at the time. This was the driving conditions to for the “cape” house style. A compact 1.5 story structure with low ceilings; easy to heat; zoned by a central chimney with rooms that could be closed for the winter. Small windows and a crushed clamshell and seaweed insulation combined with a roof that deflected wind saved huge amounts of wood, which at the time needed to be imported or collected from the beach as driftwood. Additionally, houses were located in valleys away from the worst winds and adjacent to the best soils.

Technologies continued to develop that drove away the need for generations of folk wisdom with regard to energy conservation. Tar paper, concrete block, coal stoves and eventually gas furnaces create a condition that allows for warm buildings in nearly any site condition. Deep wells and windmills replaced evaporation and water control via intensive microclimate modifications. The result was disastrous as previously productive and resilient landscapes became denuded of trees and wind caused erosion, giant snow drifts, and the drying out of land.

In response there has been a widespread adoption of planting windbreaks. This points to an interesting phenomenon. A planted windbreak of trees will not yield results for 15-20 years. That necessitates a point of view that looks at least that far into the future. This point of view is typically found in multigenerational farms. It is critical to create a farm context that brings in the long view both for design decisions and the ability to imagine a world without fuels and technologies that we take for granted.



**Figure 11: Gilsum: Early 1900s
(Public Domain)**

Local Context⁴⁸

The specific site for this study is located in the town of Gilsum, New Hampshire, a small town of about 800 people about 8 miles north of Keene, NH and the nearest supermarket. Like many rural towns in New England, the per capita income and cost of living are below the national average and just above poverty. The average age is 41, the ethnicity is 98% white, and the male female split is about 50-50. Keene (population 22,000) is the closest urban center with a slightly younger (35 yrs) population and access to more diversity, cultural opportunities, and slightly higher wages.

In the context of Cheshire county, Gilsum represents a common condition for southern New England town. Cheshire county is home to 78,000 people, two-thirds of which are rural. Seventy percent of the residences are owner occupied

and house families. The most common industries for men are construction (16%), metal and metal products (8%), repair and maintenance (8%), administrative and support and waste management services (6%), educational services (5%), truck transportation (5%), and groceries and related products merchant wholesalers (4%). Women work in health care (12%), educational services (11%), miscellaneous manufacturing (10%), finance and insurance (10%), accommodation and food services (5%), professional, scientific, and technical services (4%), and data processing, libraries, and other information services (3%). Though not the generalists of the settlement period, the simpler infrastructure of rural places offers the opportunity to continue the tradition of the ‘Jack of All trades.’”

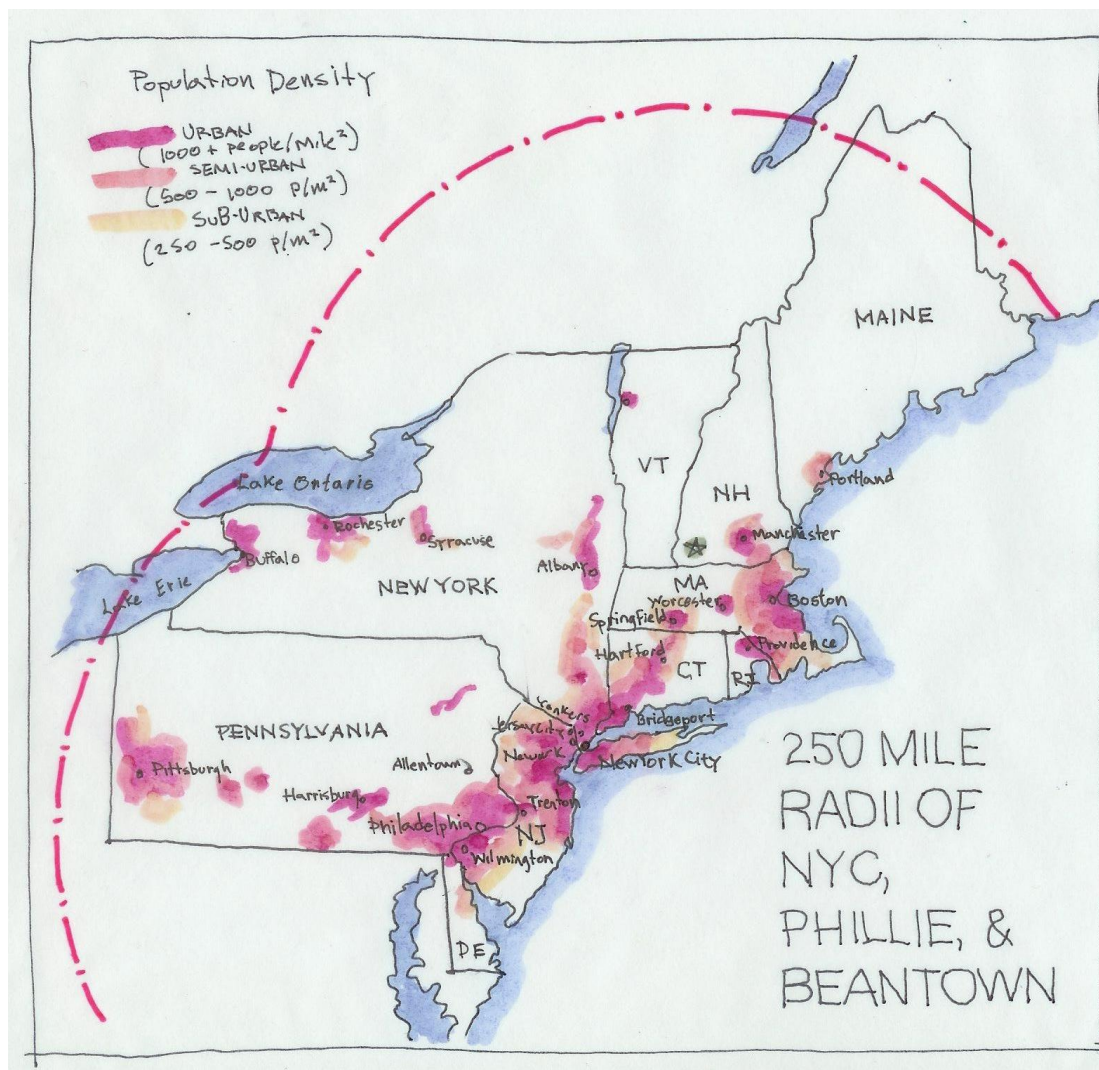
Other similar towns are spread out evenly throughout the region every 5-10 miles with an infrastructure of electricity, phone lines, paved and dirt roads, gas stations and general stores, residences, schools, and small businesses. It is a rugged landscape of forest, steep hills, streams and rivers, and some agricultural land. A cold temperate climate of 7500 heating degree days⁴⁹ (compared to 6500 in Amherst) sees three to four inches of precipitation per month with a few feet of snow each winter.

In the 700 square miles of land the population, density is fairly low (110 people per square mile). As points of reference, New York County (Manhattan) has over 70,000 people per square mile and Manila’s density is well over 100,000 people per square mile.⁵⁰ If we consider food as a product of soil plus air, water, sunlight, and the labor required to produce it, an interesting condition

arises: rural areas with the land base for food, but not the labor, and urban areas with labor, but not the land base. This complementary relationship represents a potential future of rural and urban connection currently not developed in this country.

An icon of the progressive design movement, Bruce Mau states in his book, *Massive Change*, that, “Density offers hope: With nearly half of the world’s population living in cities, density is increasingly becoming the global condition. The denser we can make our cities, the more we can sustain ecosystems.”⁵¹ The material needs, which under current technological, intellectual, and cultural conditions, cannot be met by the land base that houses those people, will play a critical role in the interplay between urban, rural, sub-urban, and sub-rural areas.

Rural New England is within 250 miles for over 20 million city dwellers. The productive land base and regional foodshed for cities in the Northeast may once again include the 13 original colonies. In summary, rural New England’s food infrastructure will change again. That change is already beginning. The existing condition for that change is in need of repair.



**Figure 12: Population Map of Northeast
(After GeoNova, 2003)**

Notes

- ¹ Michael Pollan, "Farmer in Chief," New York Times Magazine Oct 9 (2008).
- ² Roger Doiro, "On World Food Day: Crunching the Numbers," CommonDreams.Org, <http://www.commondreams.org/view/2009/10/15-8>.
- ³ Andrew Kimbrell, *Fatal Harvest: The Tragedy of Industrial Agriculture* (Washington: Island Press, 2002), 224.
- ⁴ Jesse JW Selman, "The New and the Old: A Sociological Look at Rural Vermont" (BA Thesis, Vassar College, 1996)
- ⁵ Jonathan Safran Foer. *Eating Animals*. (New York: Little Brown and Company, 2009), 1.
- ⁶ Donella Meadows. *Limits to Growth: the Thirty Year Update*. (White River Junction: Chelsea Green Publishing Company, 2004)
- ⁷ Chris Martenson, "Crash Course," www.chrismartenson.com
- ⁸ Rob Hopkins. *The Transition Handbook: From Oil Dependency to Local Resilience*. (Totnes: Green Books Ltd), 2008. 80-83
- ⁹ David Holmgren, "Energy Futures," <http://www.futurescenarios.org/content/view/16/31/>
- ¹⁰ Donella Meadows. *Limits to Growth: the Thirty Year Update*. (White River Junction: Chelsea Green Publishing Company, 2004)
- ¹¹ Wendell Berry. *The Selected Poems of Wendell Berry*. (Washington DC: Counterpoint, 1998.) 87-88.
- ¹² Dave Jacke and Eric Toensmeier, *Edible Forest Gardens: Ecological Vision and Theory for Temperate Climate Permaculture* (White River Junction: Chelsea Green Publishing Company, 2005), 23.
- ¹³ Roger Doiro, "On World Food Day: Crunching the Numbers," CommonDreams.Org, <http://www.commondreams.org/view/2009/10/15-8>.
- ¹⁴ Ibid.
- ¹⁵ Matthew Kling and Ian Hough, "The American Carbon Footprint: Understanding And Reducing Your Food's Impact On Climate Change" (Brighter Planet, 2010), 9.
- ¹⁶ Bill Mckibben, Keynote address to Orion Society at the Bershire Grassroots Summit, August 2006.
- ¹⁷ James Howard Kunstler, *The Long Emergency: Surviving the End of Oil, Climate Change, and Other Converging Catastrophies of the 21st Century* (New York: Grove Press, 2005), 239.
- ¹⁸ Ibid.
- ¹⁹ Ibid.
- ²⁰ Jonathan Safran Foer. *Eating Animals*. (New York: Little Brown and Company, 2009), 34.

²¹ Ibid., 43

²² Ibid., 105

²³ Michael Pollan, "Farmer in Chief," New York Times Magazine Oct 9 (2008)

²⁴ USDA, "2007 Census of Agriculture: Small Farms" (National Agricultural Statistics Service, 2007)

²⁵ Roger Doiro, "On World Food Day: Crunching the Numbers," CommonDreams.Org, <http://www.commondreams.org/view/2009/10/15-8>.

²⁶ Joan Schaffer and Billy Cox, "Number of Farmers Markets Continues to Rise in U.S.," USDA, [http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateU&navID=&page=Newsroom&resultType=Details&dDocName=STELPRDC5072471&dID=100574&wf=false&description=Number+of+Farmers+Markets+Continues+to+Rise+in+U.S.+&topNav=Newsroom&leftNav=&rightNav=&rightNav="](http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateU&navID=&page=Newsroom&resultType=Details&dDocName=STELPRDC5072471&dID=100574&wf=false&description=Number+of+Farmers+Markets+Continues+to+Rise+in+U.S.+&topNav=Newsroom&leftNav=&rightNav=&rightNav=&rightNav=)

²⁷ Voyager, "Reported Occupations – U.S. Labor Force, 1850-2000 (source: <http://ipums.org>), http://flare.prefuse.org/launch/apps/job_voyager.

²⁸ Sir Albert Howard, preface to *An Agricultural Testament* (New York and London: University Press, 1943), ix.

²⁹ Sir Albert Howard. *An Agricultural Testament* (New York and London: Oxford University Press, 1943), 25.

³⁰ Ibid, 222.

³¹ Ibid, 224.

³² Rob Hopkins, *The Transition Handbook: From Oil Dependency to Local Resilience* (Totnes: Green Books Ltd, 2008), 71.

³³ Ibid, 55.

³⁴ Ibid, 54.

³⁵ Michael Pollan, "Farmer in Chief," New York Times Magazine Oct 9 (2008)

³⁶ Ibid.

³⁷ Bill McKibben, *Deep Economy: The Wealth of Communities and the Durable Future* (New York: Times Books Henry Holt and Company, 2007), 165.

³⁸ Norbert Schoenauer, *6,000 Years of Housing* (New York: W.W. Norton and Company, 2000), 57.

³⁹ Ibid., 60-61.

⁴⁰ John Michael Vlach, *Barns*. New York (W.W. Norton & Company, 2003.), 247.

⁴¹ Thomas C. Hubka, *Big House, Little House, Back House, Barn: The Connected Farm Buildings of New England*. (Hanover and London: University Press of New England, 1984).

⁴² Abenaki Nation, "Abenaki History," <http://www.abenakination.org/history.html>.

⁴³ New Hampshire Public Television, "Knowledge Network: People of the Dawn," <http://www.nhptv.org/kn/itv/ournh/ournhtg2.htm>.

⁴⁴ John Cochran Wooley, *Farm Buildings*. (New York: McGraw Hill, 1946.) 2.

⁴⁵ *Ibid.*, 4.

⁴⁶ *Ibid.*, 6.

⁴⁷ John R. Stilgoe, "A History of Microclimate Modification: 1600 to 1980," in *Energy Conserving Site Design*, ed. E. Gregory McPherson (Washington: American Society of Landscape Architects, 1984), 3-16.

⁴⁸ City-Data.com, "Gilsum, New Hampshire," <http://www.city-data.com/city/Gilsum-New-Hampshire.html>.

⁴⁹ Weather Underground, "BizEE Degree Days; Weather Data for Energy Professionals: Custom Degree Day Data," <http://www.degreedays.net/>.

⁵⁰ 2007 Census of Population, "Population and Annual Growth Rates for Region, Provinces and Highly Urbanized Cities (Based on Censuses 1995, 2000 and 2007)," <http://www.census.gov.ph/data/census2007/index.html>

Office of the President MMDA, "Metro Manila at a Glance," <http://www.mmda.gov.ph/metromla.html>.

⁵¹ Bruce Mau and The Institute Without Boundaries, *Massive Change*. (New York: Phaidon, 2004), 37.

CHAPTER 2

OBSERVING & VISIONING A NEW FOOD SYSTEM

Introduction

The site for this design exploration is typical to the condition of many New England farms today – lacking farmers and investment. Currently, there is a small community forming who have the goal of reviving the agricultural capacity of the place in both labor and capital. Their approach will be in culture, food, and soil. They are working with a landscape design group to envision a master plan for the community. The goal of this study is to look at the built environment of food as it fits into their larger vision.

People

Hollow's End Farm is located at the end of a dirt road outside of Gilsum, New Hampshire. There is one owner who has actively begun the process of reviving the agricultural and community pursuits on the land. The group has a dynamic and evolving vision. Below is a summary of their thinking as last winter (2009-2010).¹

Summary: The long-term vision for the properties is to develop a small community of like-minded folks who work together on agricultural projects. These may include raising livestock (goats, chickens and possibly sheep), vegetables, and fruit, nuts and berries. Over time, the properties should have educational component. A low-intensity retreat center is also in early planning for one of the properties. This will consist of several small three-season structures (like yurts)

and a common building for classes, workshops, bathrooms, kitchen, eating, hang-out. The retreat center will be a later phase of this project.

General

- The community at Hollow's End models net-zero buildings for all new and remodeled structures
- Land at Hollow's End is managed with best ecological practices: max function and beauty, good for wildlife and humans.
- The owner's primary values are aesthetic and social.

Farming

- Increase agricultural production at Hollow's End to provide a majority of the community's food needs. Some food production for sale to the greater community is also a goal.
- Not all community members will be full-time farmers.
- There is interest in having livestock at Hollow's End. Goats are most appealing, followed by sheep and chickens. Workhorses are also appealing and all new development should be easily transferrable to animal powered system.
- Permaculture and innovative methods of agriculture including no-till ag, perennial vegetables and polycultures. Farming developments should be appropriate to the level of care they will receive as well as good models for diverse, climate resilient systems.

Organizational Structure

- The ownership structure and legal status of the project / property require further exploration.

Siting the Farm Center: Building a farm center at Hollow's End could dramatically improve the productive capacity of the property. A well-positioned, well-organized, farm center will make property management more efficient by providing the physical infrastructure for work systems. The farm center itself can provide a consistency of property management, even as participants change. It will make also signal to potential participants of Hollow's End that this is a place that takes itself seriously. Construction of a farm center is a significant investment of time and resources. It will impact the land for generations to come. All the details of its siting, design and construction, must be carefully considered. The ideal location for a farm center would meet the following objectives:

- Central to all of the parcels of land that make up Hollow's End
- Accessible from a well built, reliable road
- Close to fields
- Close to productive forest land
- Close to potential home sites for participants at Hollow's End
- Close to a winter animal yard
- Has room for expansion
- Minimizes undesirable views, noises, and odors from Catherine's home zone
- Minimizes undesirable views, noises, and odors from the future retreat center
- Buffered from important habitat resources (>100' from streams and ponds)
- Not built on prime agricultural soils
- Sheltered from winter winds
- Has good solar access
- Is inspiring (good views, strong sense of place, beautiful)
- Outdoor areas are relatively flat (<8% slopes)

- Minimizes electrical runs
- Near potential well and septic sites

The barn will be a "farm center" that will serve a small farm community.

The farm center will provide a central location where community members can meet, share resources, and develop a sense of common purpose. Our current list of elements for the barn is:

- storage for shared machinery, tools
- processing facilities for vegetables and dairy products
- commercial kitchen
- machine and wood shop
- firewood processing
- community room/classroom
- possibly housing for humans
- possibly milk parlor
- possibly animal housing
- storage space for bulk landscape materials (woodchips, gravel, sand, etc.)
- possibly food storage for humans and animals
- The barn should collect energy and water and minimize resource use
- The barn should provide room to grow and adjust to changing economic conditions, business models, and natural resource availability

Existing Conditions

Land: approximately 225 acres

- 14.25 currently open.
- 2.4 acres of the open land is nationally designated prime farmland.
- 7 acres is farmland of statewide importance.
- The vast majority of the land is forest much of it on steep slopes.

- There is an active forest management plan in place for the forest land.
- There are 3 ponds and numerous streams which are part of the Ashuelot River watershed (the Ashuelot is ecologically important).
- The land is a focus area in New Hampshire's Wildlife Action Plan-largely because of its streams and because it is part of a large block of forest that has minimal human impact.
- The properties are approximately 10.5 miles from downtown Keene NH.



Figure 13: Aerial View of Site
(Used By Permission from Salamander Unlimited)

Property Breakdown

- The project area is comprised of four properties owned by a single individual (all on Hammond Hollow Road).
- Three properties are adjacent but there are two intervening properties along the road frontage.
- The two intervening properties are a home and a commercial greenhouse which grows flowers.

- The intervening properties are owned by one family.
- The fourth property is about a 1/3 mile away on Hammond Hollow Road.
- The main property and focus of this work has a two-family house, a small barn-like structure, and a larger timber frame structure with no siding. Both are storage spaces currently.
- Another property has a two-family house and a detached garage with an attached small 3-sided animal shed (10x10'?)
- A third has one two-bedroom log cabin with a detached two-car garage with a second floor.
- All the properties are inhabited by people interested in sharing a larger vision

Site Analysis

The fabric of this landscape has been manipulated throughout the years and the resulting form is a wrinkled network of habitats. It is diverse, beautiful, and can be experienced as a series of outdoor rooms or spaces, each with their own qualities of light and dark, moist and dry, secluded or open, etc. Encounters with the site consistently offer new insights as weather and seasons and time of day progress. The complexity of the landform, flora, and hydrology create a rich palette onto which an agricultural system can be applied.



Figure 14: Existing Site Map

The map above (Figure 14) shows an existing infrastructure that ends at central terminus. Based on the existing roads, foundations, water lines, and other interventions, etc. this is the ideal location for development. The original barns were also located adjacent to the house.

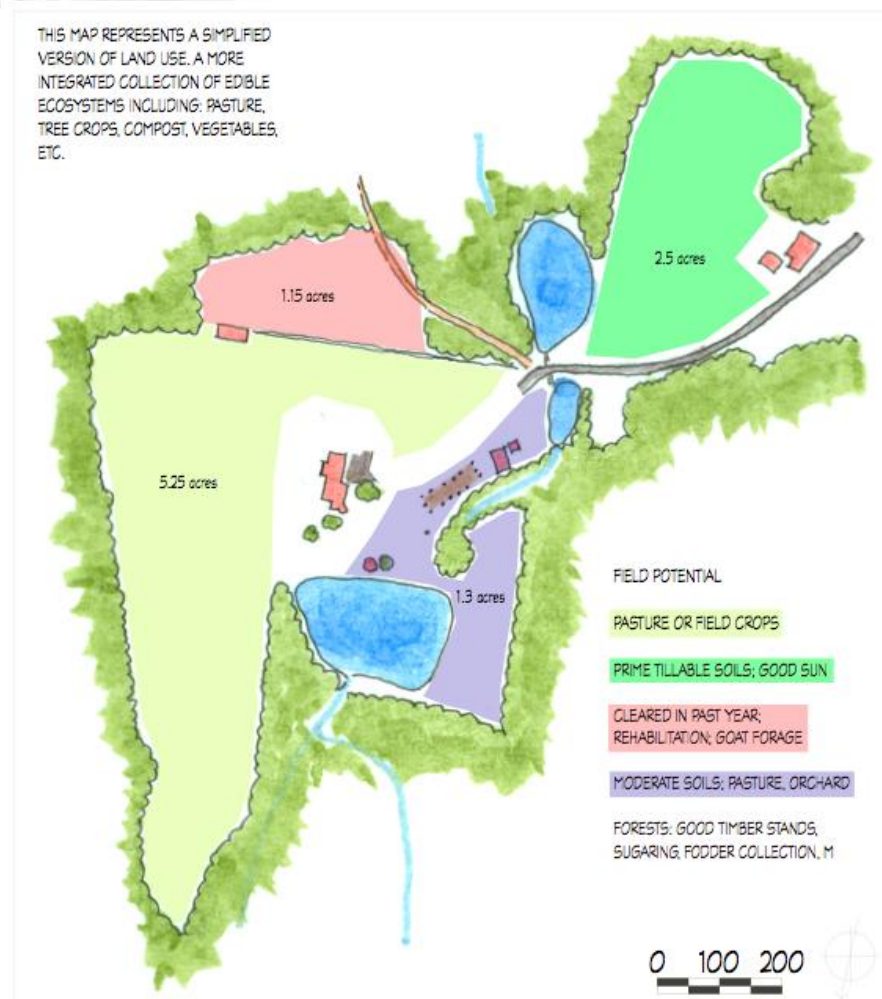


Figure 15: Fields / Soil

Figure 15 shows a course analysis of the sites open fields. Some clearing for additional open spaces would yield additional acreage. As noted, this is a simplified version of what would be a more integrated farm system. It does, however, point toward certain base uses. One conflict that arises is the distance of the prime vegetable field from the proposed farm center.

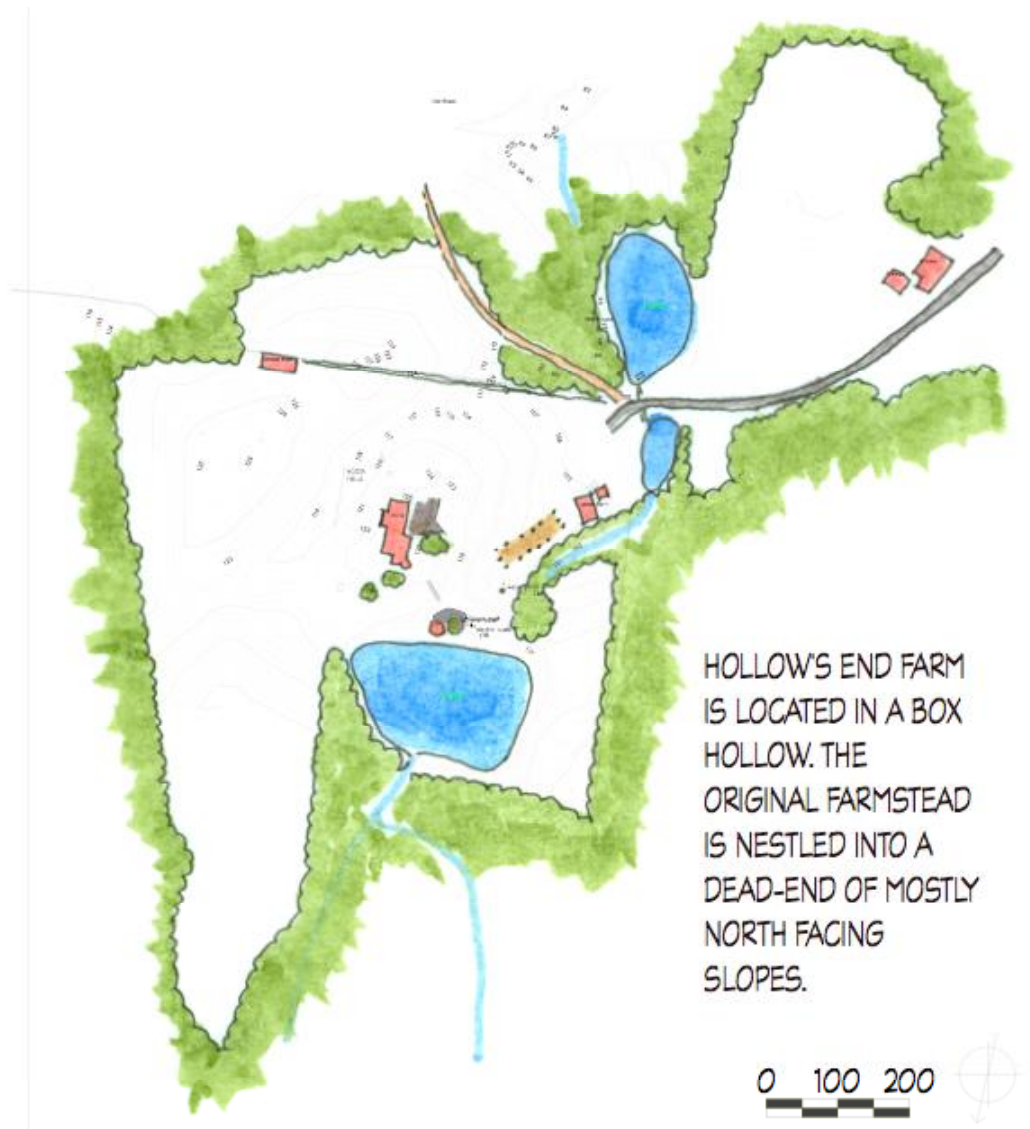


Figure 16: Topography

Figure 16 shows the site topography. This map alludes to a condition that is better understood with a site visit: the area directly north of the main house has an awkward north slope followed by a low and flat, but dry, spot, followed by the only south facing slope. The combination of the south slope and north slope in need of repair create a condition very desirable for development.

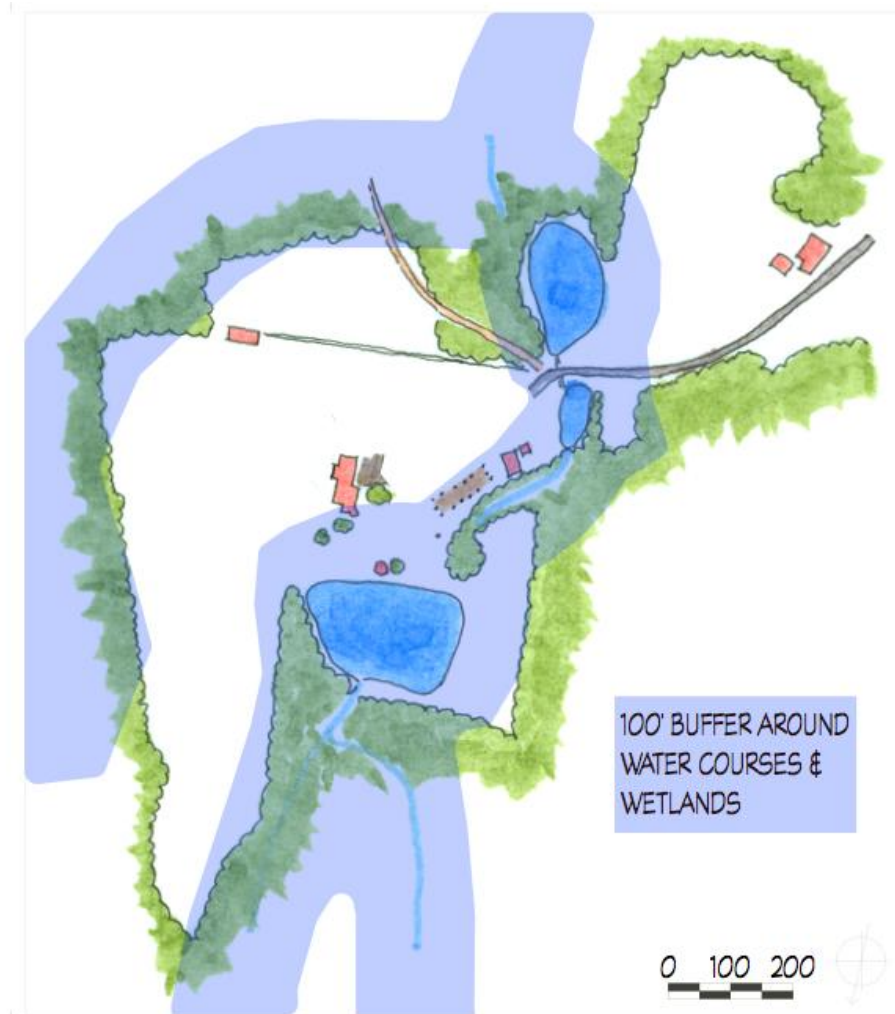


Figure 17: Hydrology

The way that water moves the site has both limiting and enabling effects for the potential strategies of site development. (Figure 17) Respecting a one hundred foot riparian buffer reinforces the strategy of locating development to the north of the house. Water for agricultural and wild ecosystems is abundant and accessible from the entire site. Future projects could include a gravity fed water system or micro hydro-electric. It is unlikely that there is enough water for any mill facilities.

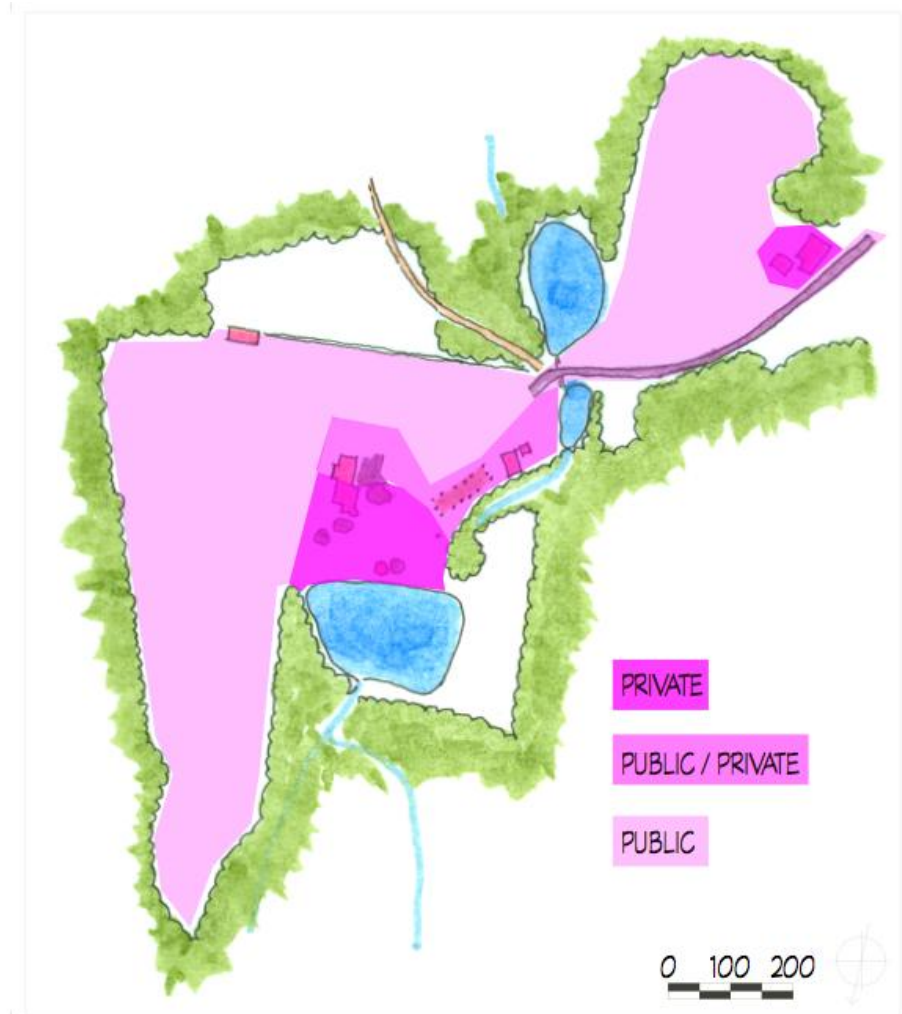


Figure 18: Public / Private

Analysis of public/private space drives the site program to enhance privacy and quiet space to the south of the house and north of the upper pond. (Figure 18) This analysis also creates a push to move the primary entrance further to the north. The fields and forests beyond are safe, accessible public space for recreation. Areas directly around the entry and buildings may be considered less accessible for farm traffic and safety reasons.

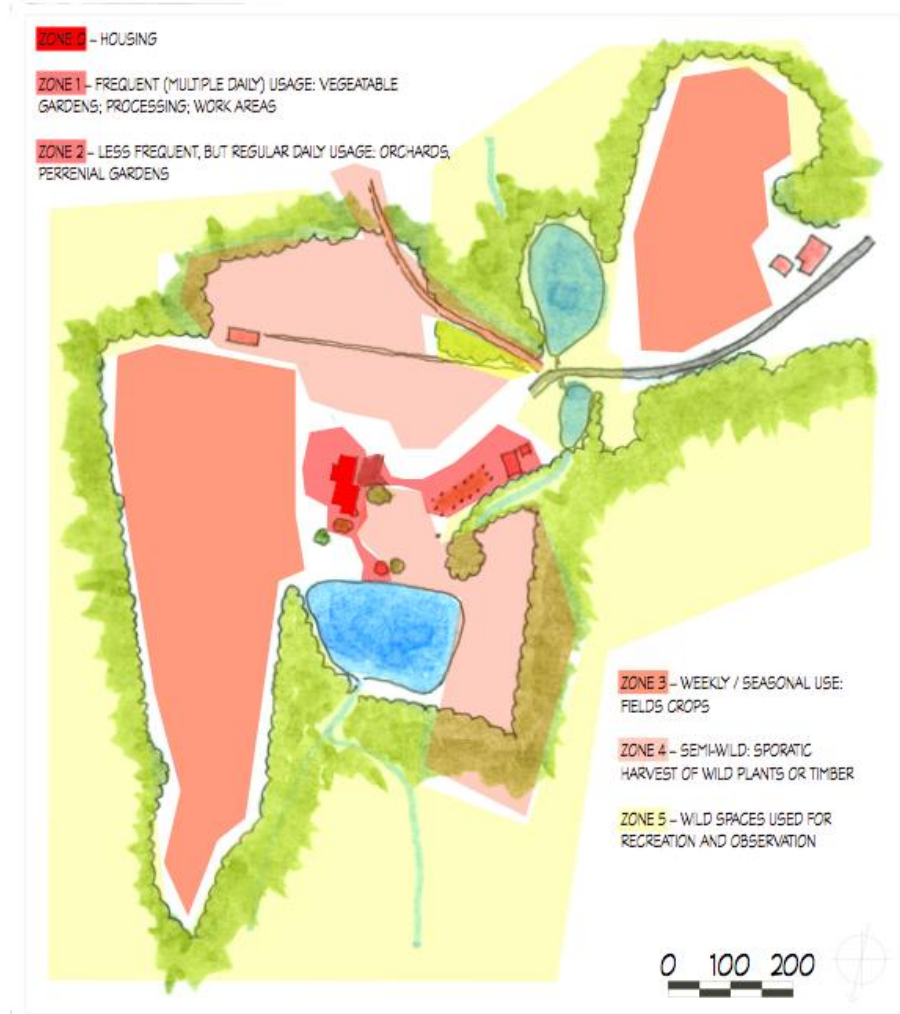


Figure 19: Zones of Use

The zones of use show the current usage patterns. The addition of a farm center to the north of the house would expand and maintain the existing patterns that had developed over a few centuries of habitation. The final design will seek to create a logical concentric pattern of use with efficient access to spaces and respect for changing modes of transport.

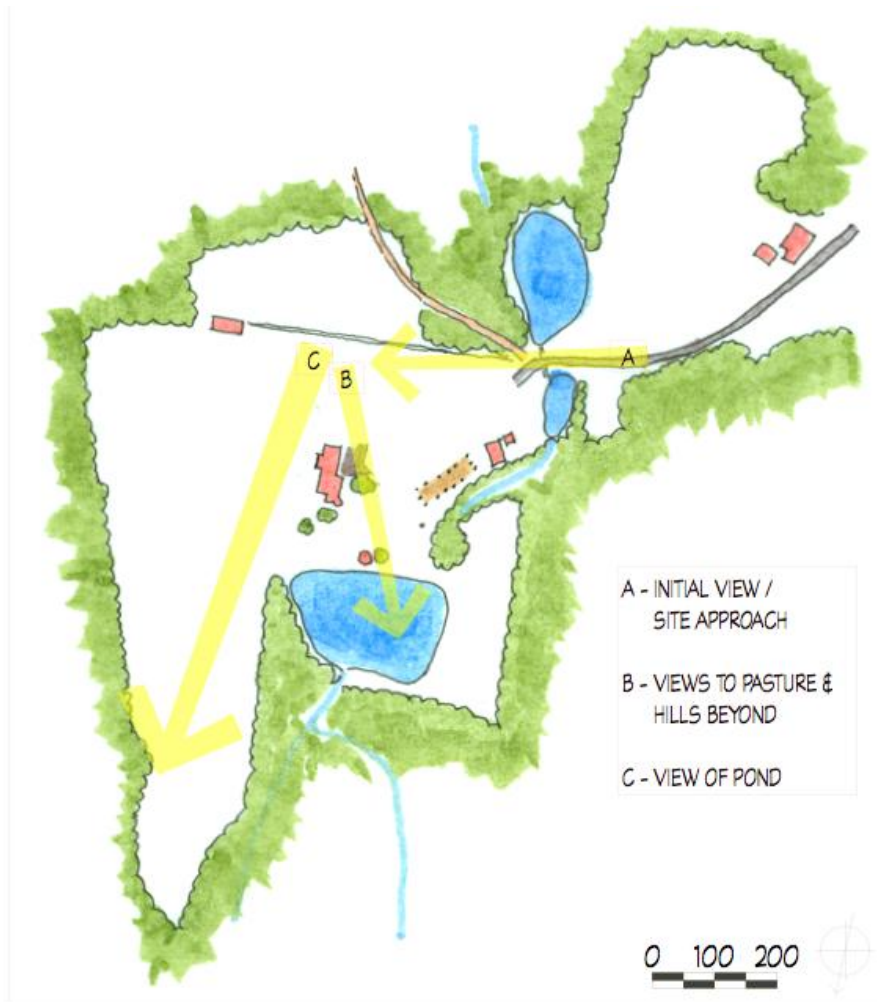


Figure 20: Views

The experience of entering the site defines the character of one's relationship to the place. The approach view to the site is currently blocked by mature evergreens and has no clear destination. As these trees are ready for harvest, it makes sense to cut them and use the wood for construction. This will create a view of the area to the north of the house and draw people to that site. Once there, significant views of the rest of the property are revealed. (Figure 20) Careful fine-tuning of window location and heights could generate both

picturesque views as well as functional sightlines to important site features, such as the entry road, gardens, pastures, or work yards.

This approach also takes into consideration the existing on-site precedent. (See Figure 9 & 21). The original farm utilized the dooryard pattern to create access to the buildings, a protected microclimate, as well as to create a formal approach that connects people to the working and social components of the farm.

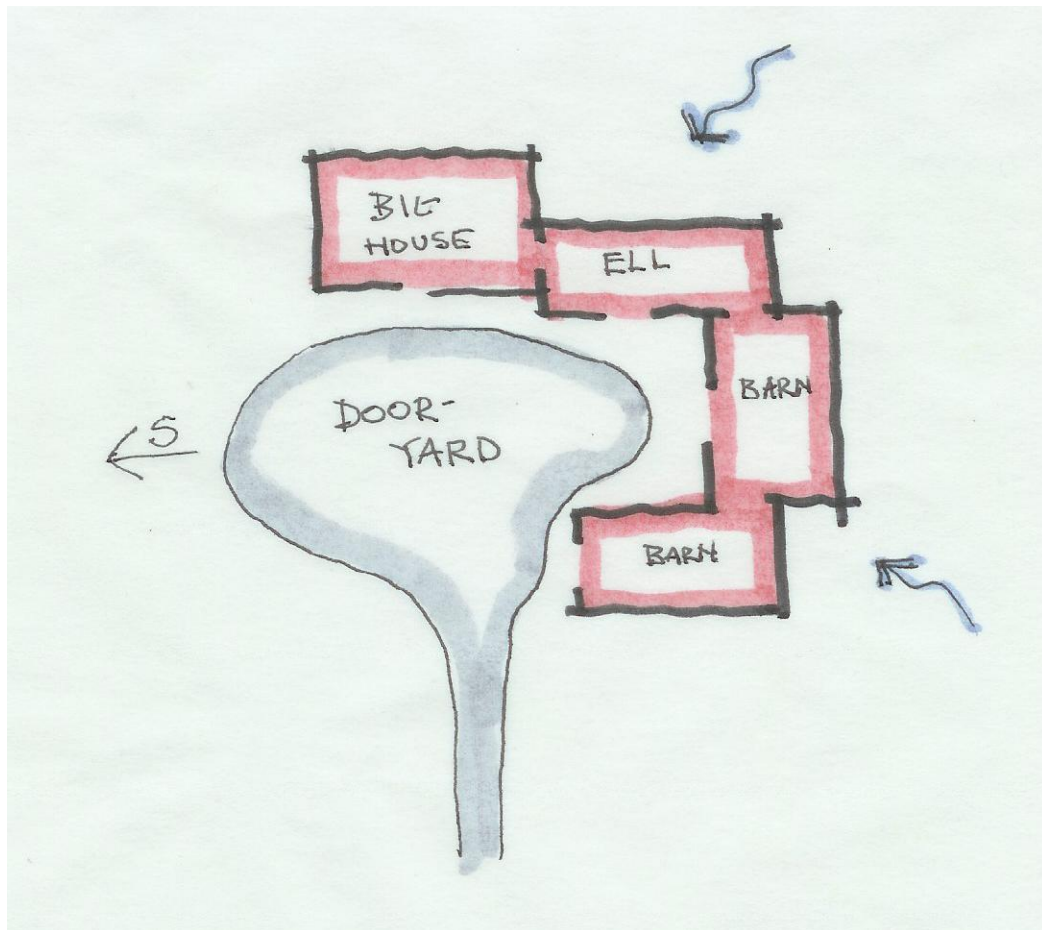


Figure 21: Hollow's End Historical Dooryard

Regulation

The diverse farm operation that raises both animals and vegetables may benefit from the rising price healthy animal products such as raw milk. In New Hampshire milk and milk products are regulated by the Department of Health and Human Services, Food Protection Section, Dairy Program. Raw milk is allowed, but discouraged. Milk Sanitation Licenses and Milk Producer Permits are designed to protect the public from food-borne illnesses. The infrastructure requirements are basic common sense, leave room for interpretation, and are not overly burdensome.²

Gilsum has a well developed inspection process, site plan review, and oversight compared to the many less regulated rural towns in rural New England. Zoning is generally favorable to agricultural pursuits. However, new endeavors can be subject to review.³

Most farm building are exempt from all but the minimum building code enforcement. However, this program may include spaces that host the general public. Both for common sense and code, all life safety and accessible guidelines will be followed for these aspects of the project.

Visioning

An expression of goals coupled with an active, engaged, and informed visioning process is key to any design. The goal is the intention and the vision is the tool that allows us to know when we have achieved that goal.⁴ The design itself is the manifestation of the strategies that take us from goal to realization.

There is no one approach to creating a resilient, regenerative farm. Every farm, farmer, and situation are different. Soils, preferences, and markets will vary widely, even within a climate-similar region. Each endeavor and associated structures must be tested against what the land can support, the markets can support, and the capacity and preferences of the individuals involved.⁵ An additional layer of consideration must imagine the infrastructure throughout its lifespan existing in energy and resource climates that are potentially quite different than the current conditions.

Below is a list developed by two ecological designers, Allen Francis Ferver and Ben Falk. In an examination of transitioning into a post oil world, they catalogued lists of resources necessary for a typical town in the northeast. This type of visioning exercise is critical when designing at the brink of change.

Post Oil Town Common New England List

General/Community

farm/community offices

meeting hall/multi purpose room(wedding, dances, funerals, etc)

graveyard

school and childcare

hospital/nurse/healthcare provider

warehouse, packing and shipping center

residuals handling facility (formerly waste)

commissary /store

Energy

wind, water and solar power
combined heat and power integrated
anerobic digesters
biofuels plant and storage
firewood/chip storage facility
microgrid

Food and Water

compost operation, poultry integrated
water treatment and reuse facility, greenhouse integrated
animal barns, dairy, heifers barn, piggery,
hay storage
greenhouses
nursery and orchards
sugaring operation
milking parlor and storage tanks
dairy processing, cheesemaking and cave
butchering facility, smokehouse
root cellars, frige (ice house?) and freezer
vegetable cleaning shed with roots washer (integrate water reuse/pond)
value added food processing, kitchen, canning, fermenting, etc
silos and grain storage
distillery, beer and meadery

Commerce, Processing and Maintenance

nut shelling mill
grinding mill (water powered?)
gravel pit/storage
landing, sawmill and woodshop
mechanic shop, mill and lathe for tractor and implement repair and
manufacture

materials yard, metal, wood , stone brick, block, etc
manufacturing shop
tractor/implement shed

Program

The basic programmatic framework can be seen in the diagram below.

(Figure 22) This image was described to me by a local farmer trained in holistic farm management. He described it as the chain of production.

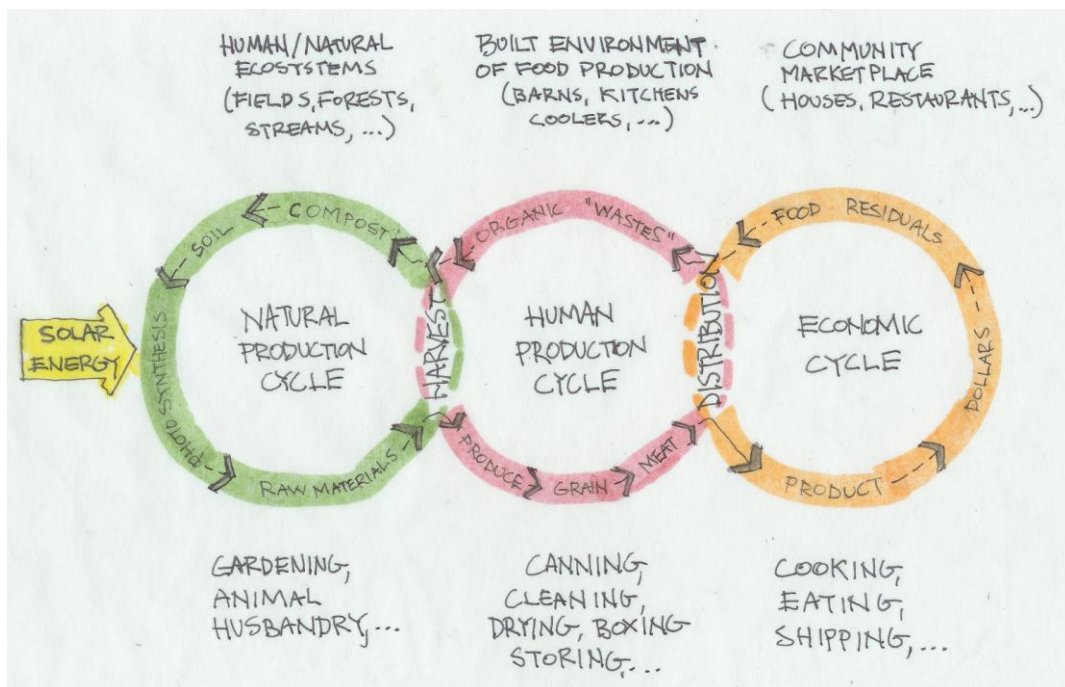


Figure 22: Chain of Production

(After David Tepher)

The first link of the chain represents the productive cycle created by photosynthesis. The energy of the sun is converted into food by plants. This may take the form of vegetables to be directly consumed by humans or pasture plants to be grazed by animals and turned into meat or eggs.

The center link of the chain represents the human production cycle. The input of human labor and technology are used to process and store the nutrients generated in the first link. The human production cycle includes harvesting, washing, packing, storing, etc. This phase would also include processing activities such as canning, freezing, drying, etc.

The last link in this conceptual model is the economic cycle. This is where the exchange of money (or other goods / services) for the food produced and handled in the first two cycles takes place.

The specific goals and program elements of this work depart slightly from the evolving vision of the owner and community described above. The program here is a little looser and based on the creation of a "farm center" that will serve a small farm community. The farm center will provide a central location where community members can meet, share resources. The facility should grow and adjust to changing economic conditions, business models, and natural resource availability. The primary goal of this community is to create food. Using the same color representations as the diagram above, the links are overlaid onto a conceptual map showing the relationship of the farm center to a larger system.

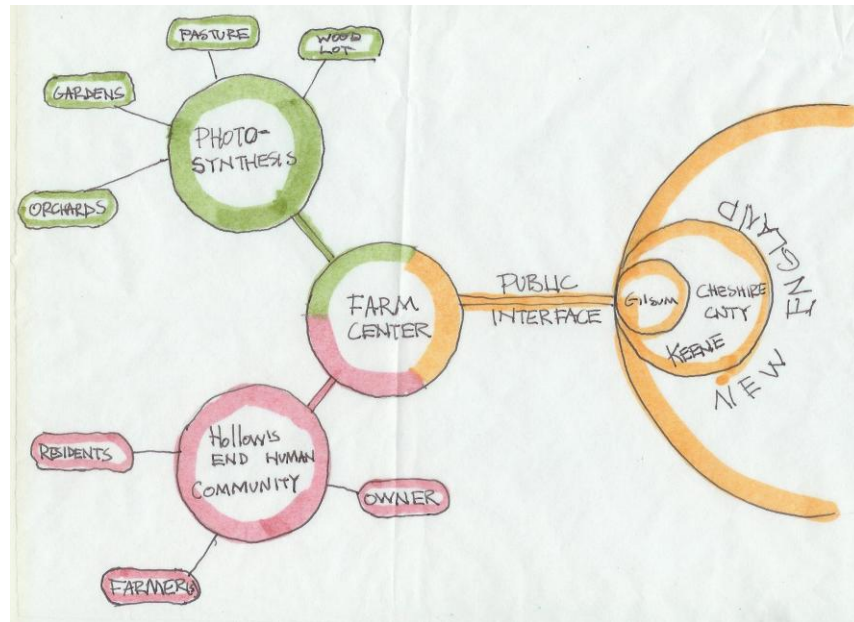


Figure 23: Concept Diagram of Farm Center

Working backwards from these goals, the productive capacity of the land, and current thinking on best practices generated the following program.

Conditioned Spaces

Community / Processing kitchen	900
Multi-Purpose Room (community classroom)	750
Human Housing	1,500+
Machine and Wood Shop	900
Food storage for humans	300
Mechanical Room	100
Milk room	100
Bathroom / Shower	70
Root Cellars	200
Office	100
<u>Sub Total</u>	<u>4,920 sf</u>

Unconditioned Spaces

Greenhouse / Graywater	200
Machinery Storage	1,400
Milk parlor	100
Additional storage	800
Animal housing	750
Food storage for animals	750

(loft volume)

Sub Total 4,000 sf

Building Sub Total 8,920 sf

Circulation, Etc. 20% 1,659 sf

Farm Center Total 9,954 SF

Outdoor Spaces

Dooryard - outdoor work area
Processing / washing facilities for vegetables
Firewood processing
Bulk Materials / Compost
Barnyard
Pastures
Vegetable Gardens

These programmatic requirements were then give a conceptual relationship to each other, again using the color code of the chain of production. Additional conceptual overlays are subsequently used to determine additional relationships, conflicts, opportunities etc.

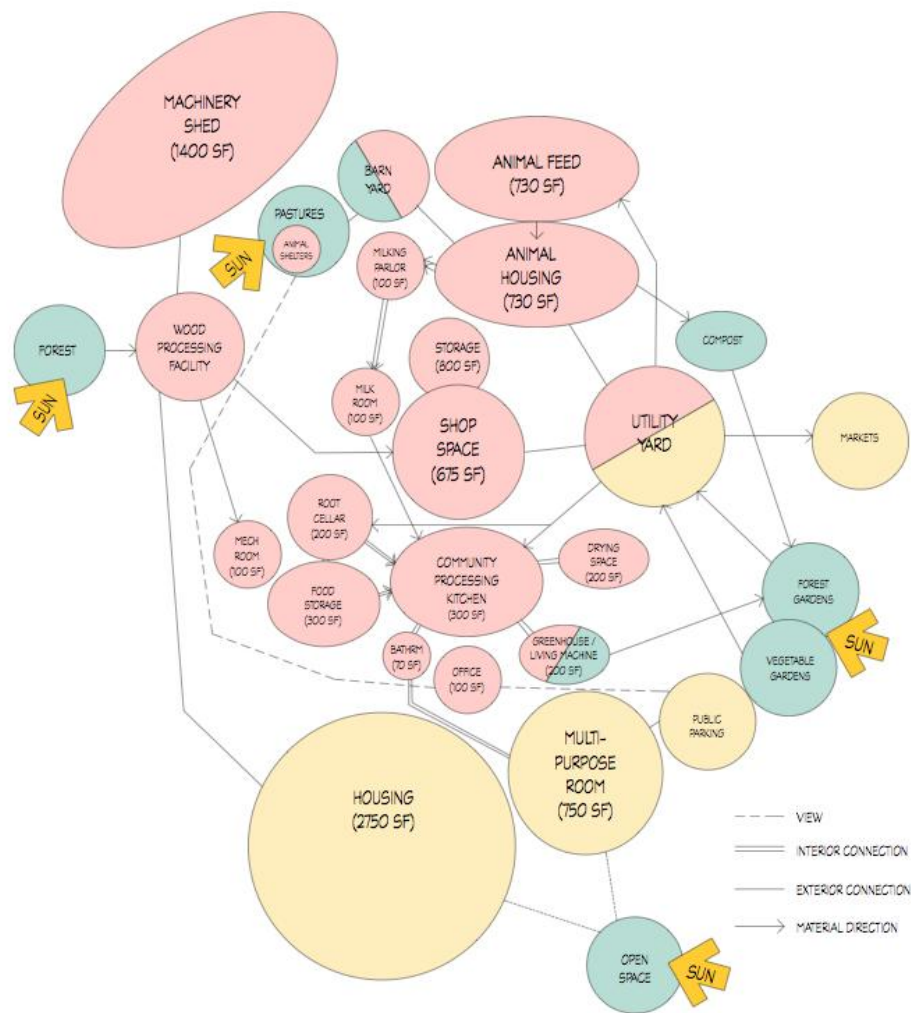


Figure 24: Base Program Diagram

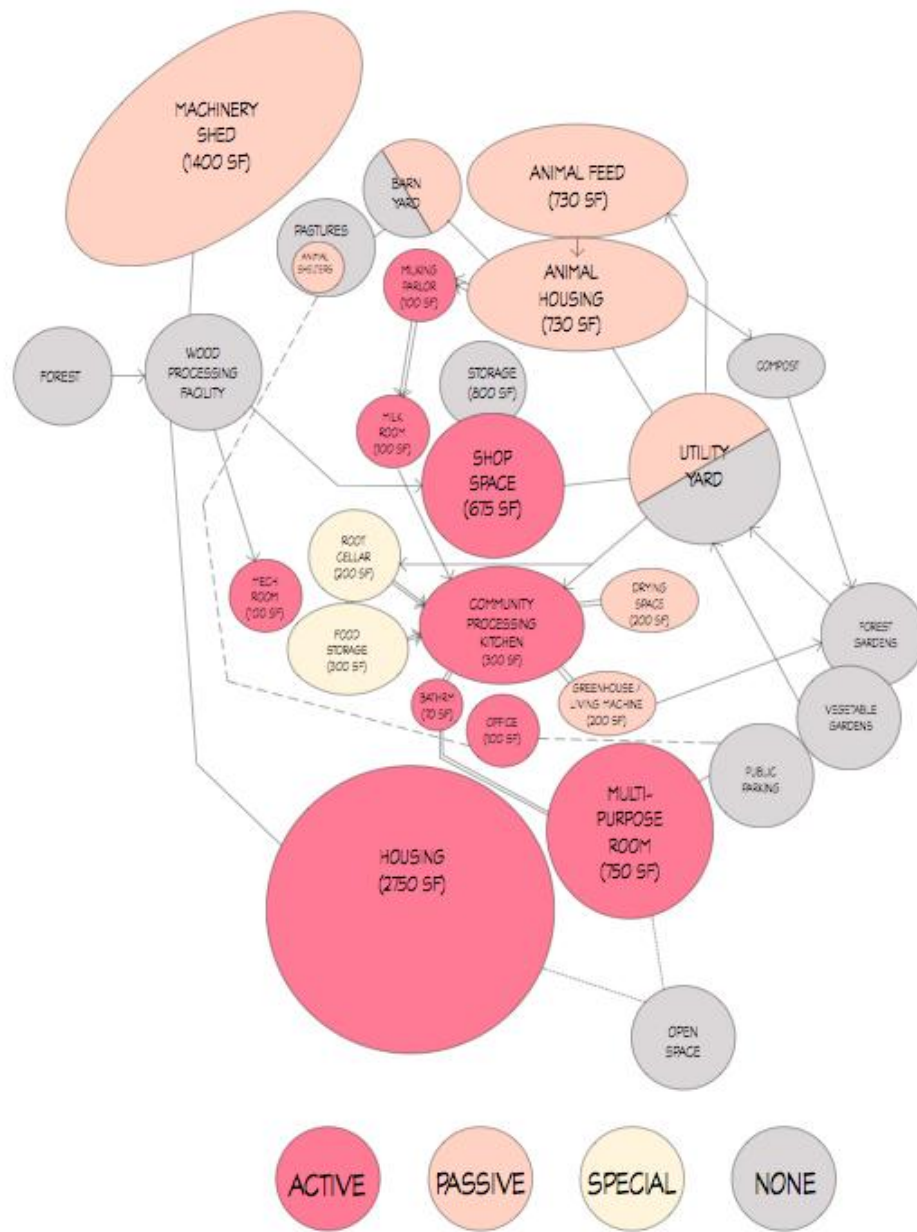


Figure 25: Program Overlay - Space Conditioning

Some of the goals of this arrangement were to: Create simple mechanical cores with robust envelopes; Cluster heated or cooled spaces together to maximize distribution efficiency; Use waste heat and free solar energy to optimize systems. (Figure 25)

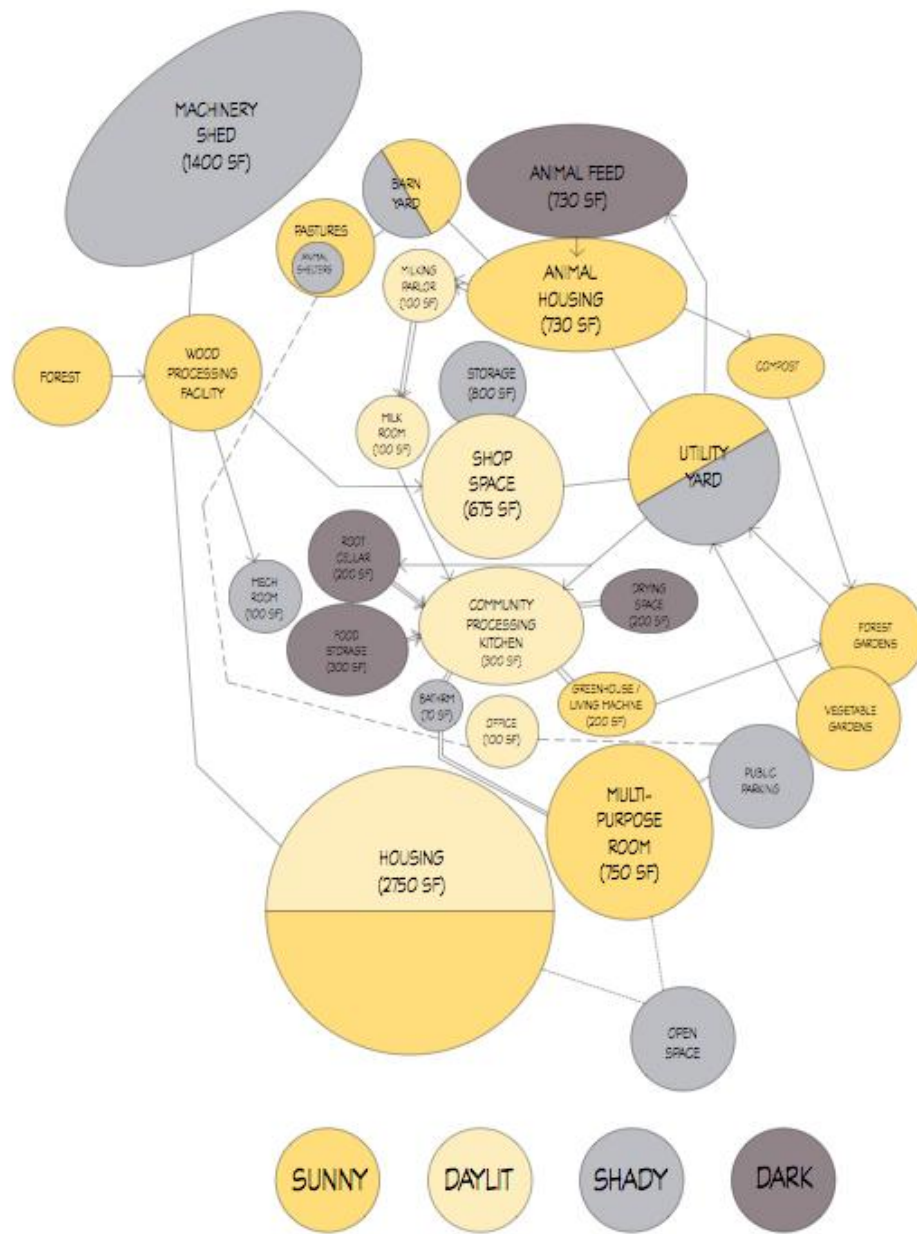


Figure 26: Program Overlay – Light & Dark

This diagram analysis (Figure 26) indicates that where the programs requires direct sunlight, trees and structures to create shading and negotiates darkness with heat and moisture.

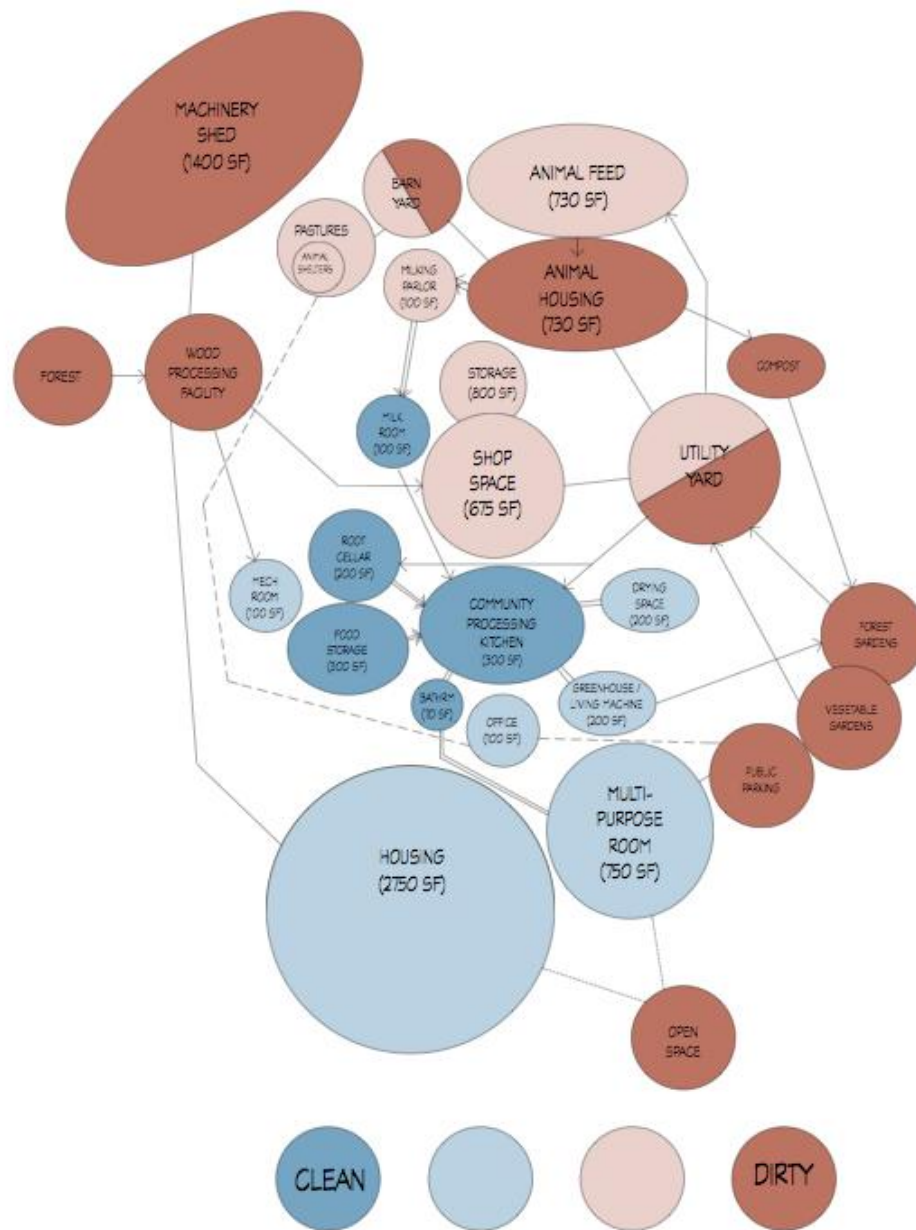


Figure 27: Program Overlay – Sanitation

Food production requires both sanitary and microbially active conditions with the management of healthy systems of micro-organisms for fermentation, composting, or cheesemaking, along side compost, humanure & greywater, and animals. (Figure 27)

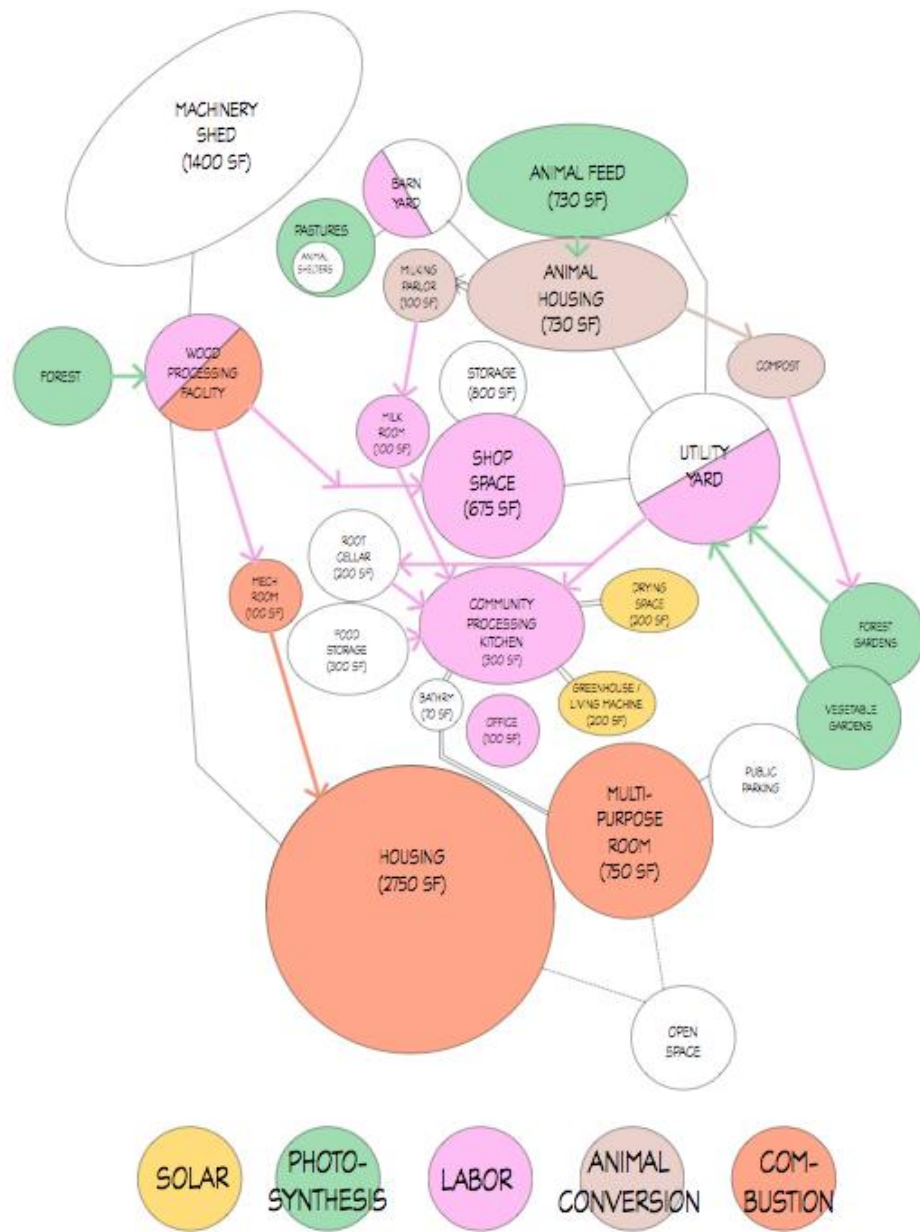


Figure 28: Program Overlay – Energy / Work Flows

The figure above (Figure 28) shows a system overlay tracing certain flows of mass and energy. This diagram illustrates a few important aspects of the programmatic relationships. Food production requires the management of calories, btus, pounds, work hours, chemical processes, etc. Primarily, there is a potential labor/work bottleneck at the center of the system. The outlet for product

is not well defined in the system. The flow of wood into heat energy faces both labor and technological hurdles before reaching habitable spaces.

Notes

¹ Initial site and program analysis based on work by Salamander Unlimited

² Starting up a Dairy In NEW Hampshire

³ Public Documents: Town of Gilsum, NH

⁴ Buzz Ferver

⁵ John Cochran Wooley, *Farm Buildings*. (New York: McGraw Hill, 1946.) 11-12.

CHAPTER 3

REGENERATIVE AGRICULTURE INFRASTRUCTURE DESIGN

From the depletion of oil to the unique folds of a sunny hillside, the designs proposed for this land are a response to the unique characteristics of place and time--geologic and cultural. This chapter begins to merge a set of design goals with existing conditions, program, and building forms. Through specific patterns, principles, and strategies, the overarching goals of the project are pursued.

Goals

To create working buildings whose material, labor, technology, and energetics strengthen a regional economy and farm ecosystem.

To create community buildings that engage the land to elegantly move energy, labor, and mass through a durable and adaptive foodscape.

To create beautiful buildings that inspire, connect, feed, and support.

Program & Landform

The complex programmatic relationships and landform were studied through conceptual models. The images below (Figure 29) show a series of iterations of this exercise. The cardboard topography and dark grey-green clay represent the existing and manipulated land, respectively. The yellow represents

utility space, red is animals, purple is community, and orange is food storage and processing.

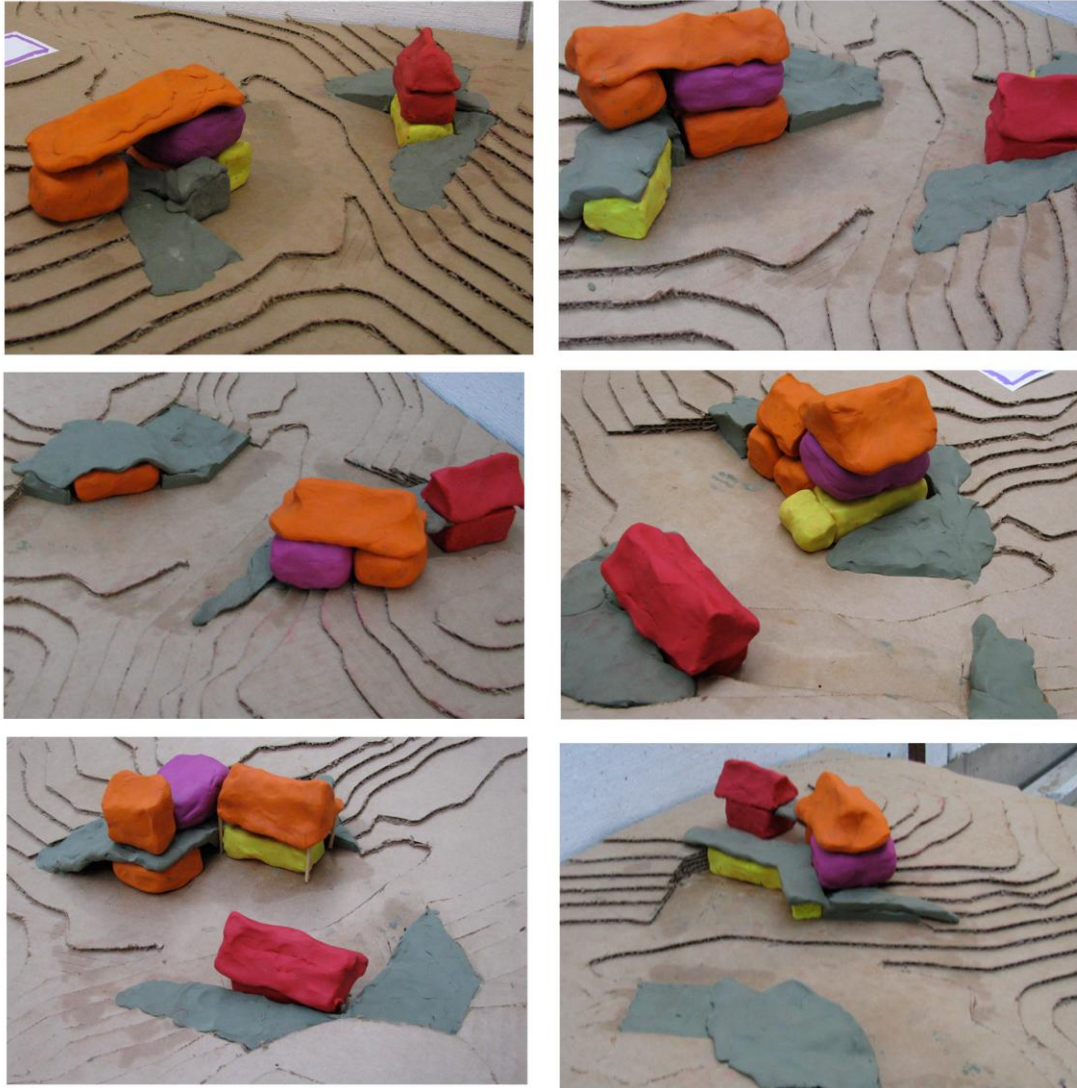


Figure 29: Concept Models

Site

Below is a conceptual site plan designed to create a central core of work & community infrastructure alongside a farmscape scaled to optimize ecosystem health, economy, and humanity. (Figure 30)

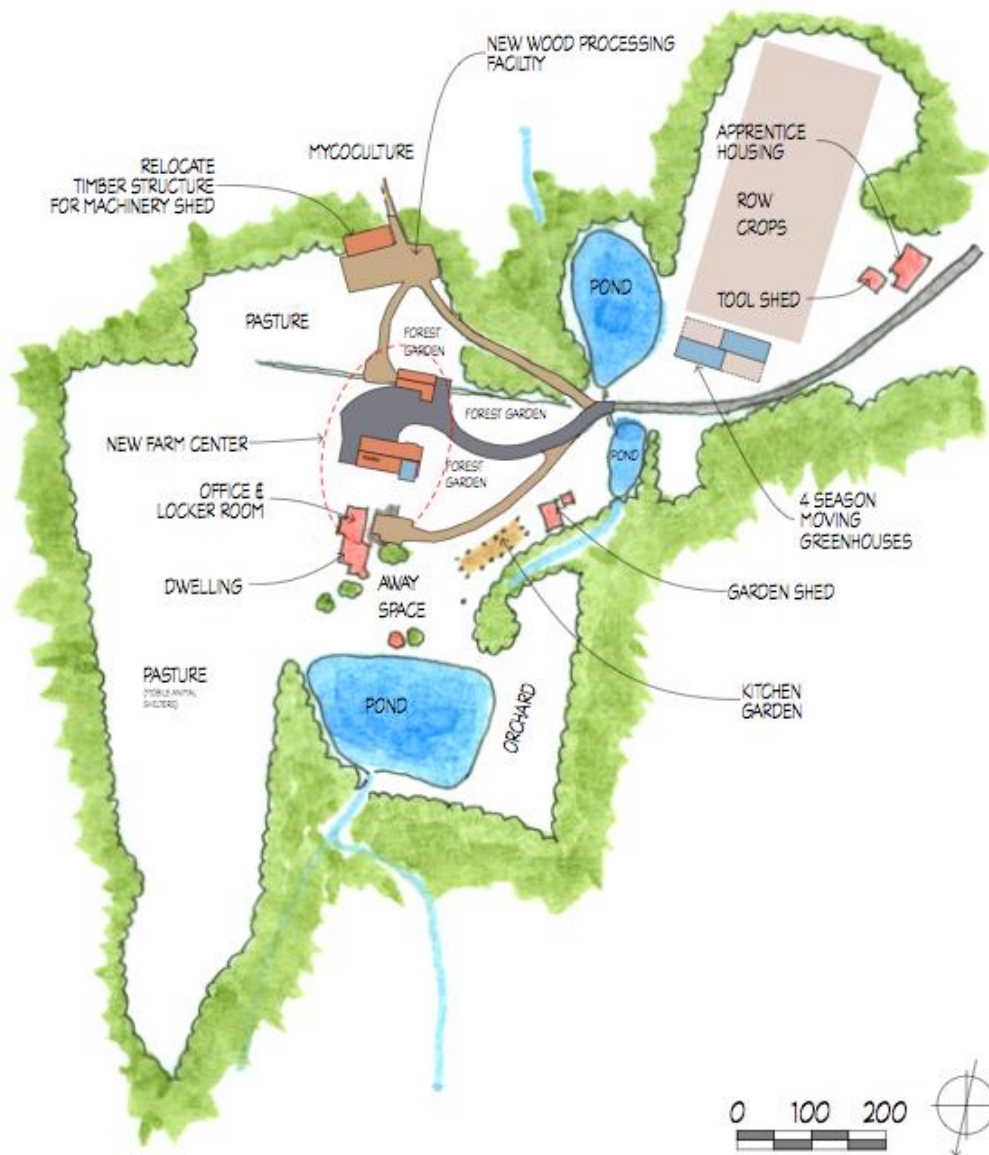


Figure 30: Proposed Site Plan

A hierarchy of roads and signage provide wayfinding and create a sense of place. Entering the site from the east, a wider gravel road leads one to the heart of the farm. To the right (northwest) is a lesser dirt road that leads to a wood processing plant. To the left (southwest) is another lesser road that leads to the residences and community spaces.



Figure 31: Entry View

The removed evergreens at the entry provide a location for low growing tree crops, which obscure but allow hints of the small farm center ahead. An old stone wall reveals a pedestrian shortcut as it climbs up the hill dying into a new stone retaining wall. Earthwork hides parking until it is needed. People in kitchens, office, and barn all have views back to the approach.

The wood processing plant sits at the transition from the main logging road to the open site. The large timber shed houses machinery, tractors, a small sawmill, and cordwood processing equipment. Cordwood is stacked on small, roofed, one-cord trailers that can be pulled by machine, beast, or a group of energetic people to house sites or the farm center for burning. A flat space around the shed allows space to park loaded wood wagons, empty hay wagons

and other implements that require large areas to maneuver. From the yard another secondary road leads to the upper level of the animal barn.

To the south of the farm center is a quiet away space which can provide respite from a hot day with a cool dip in the pond. To the southeast is a small “kitchen” garden located closer to the core for easy access of small amounts vegetables. To the north and west and occasionally to the east are pastures.

Lesser populations have deforested this region before with little uses of the massive biomass removed. By putting a strong human presence adjacent to the forests of the Northeast, it is more likely that the next deforestation will happen in a careful way that sequesters carbon, utilizes biomass and creates a healthy and productive ecosystem. The buildings needed to support this mission are proposed below.

Form

Standing on the threshing floor, diffused sunlight reaches through the open space, like the primeval forest. Great oak timbers stand proud, hardly changed from their original state. The canopy is now a thick mat of cedar shakes. The barn sits on a rock foundation--bedrock below the earth. The space is alive; it is its own ecosystem rich with habitat. Barn swallows and bats negotiate the posts and beams collecting flying insects. A Devon calf sleeps on a bed of straw remarkably like a fawn nestled on the forest floor.

The barn structure does not fight the forms from which it was built. It respects the structural integrity of the tree and the stone. The barn’s purpose does not fight the purpose of nature. The cycles of birth and death continue on. It

is a simple change in the landscape harnessing and respecting the great power of the land.

The strength and stability of strong, grounded buildings give us a feeling of strength and stability. “Firmly planted” as Thoreau described the cape¹. They offer our society “whatever it [does] not possess in sufficient supply within itself”¹ – security, certainty, justice. The experience of being within these buildings, both noble and humble – buildings that work with us and feed us – inspires us to wake up and join them in the toil of life.

The buildings sit on and push into the land, but they are separate. They accept the bounty of the land via opening and shelter it within strong walls. They let us walk in and through them, protecting us from harsh wind or bright sun. The formal language of the structures is timeless. They will not go out of style. They will weather with the years and ask us to reroof and reside them again and again.

It is common for a farm to have an old barn to be revived and guide the development pattern. Often times in the Northeast a complex of buildings provided a protected outdoor workspace accessible to all of the farm functions. This dooryard, as it is called, was part of the efficient workflow of the early American homestead. A microclimate that extends the outdoor work season and directs the flow of activities on the farm, the dooryard also acts as an organizing element for social interaction. The farm center is organized by two structures connected to the rest of the site and each other by two dooryards. To the south is the “People” Barn, creating the microclimate for the community dooryard; and to the north is the Animal Barn (barn), creating the microclimate for the working

dooryard.

The barn is a simpler building. A four bay / five bent timber frame, this structure is designed to expand in all four directions. With three levels and access on all sides, this is a very versatile barn, with the ability to host a variety of uses and arrangements. The skin is simple un-insulated wood. This is a lower cost building, with only one insulated space -- a small peninsula that houses a milk room / frost-proof supply room. Animals can come and go from the building from the north, west, east, and south, though the east is primarily a people entrance.

The people barn is comprised of two 30' x 30' structures connected above by a single roof and below by a predominantly subterranean level. It is home to a more complex core of infrastructure- kitchens, people space, food storage, mechanical room, shop, and community space. The formal language is also more complex with a number of protected outdoor spaces for work and social interaction and a semi-outdoor summer kitchen to the north.



Figure 32: Aerial View (Looking NW)

Below (Figure 33) we see a conceptual view of the farm center with raw materials, energy and work flows moving through the spaces.

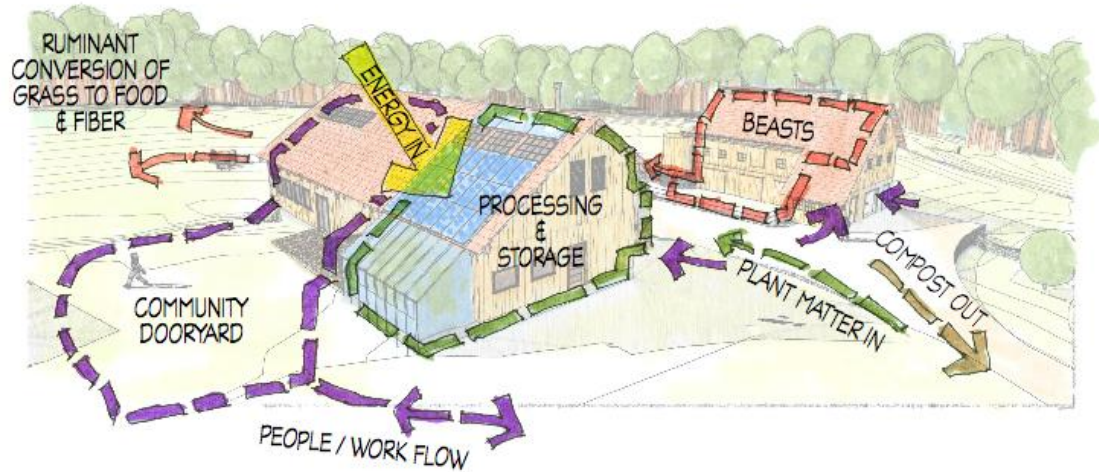


Figure 33: Aerial View Looking NW (Diagram Overlay)



Figure 34: Upper Level Plan

Based on the current population and land productivity, the farm center is somewhat oversized. Oversized facilities are designed to have a number of effects. Larger spaces, especially with animals and machines, are safer spaces. Safer spaces allow more users and observers. The assumption is that this operation will receive many visitors. Extra standing room is necessary for any educational or group projects on the farm. This gesture allows the farm to be a place where knowledge is shared, thus strengthening its connection to the community. Many farms are designed for maximum efficiency and minimal workers. These spaces are designed for an expanding community labor force and shrinking automation. A slightly oversized space can accommodate rapid expansion. Expansion can be difficult in tumultuous times, when supply chains are compromised. An over-sized facility acts as a buffer to unplanned crises, such as the millions of new farmers Pollan estimates we will need in the coming years.

This adaptability--the ability to expand or contract; to upgrade to people space; to down grade or shift spaces--is integrated into the form and reinforced in the simple reusable finishes that can be moved or composted (wood, natural plasters, etc.). These finishes also have the ability to absorb and give off moisture, depending on the relative humidity. They also support local craftspeople, production streams, and tight feedback loops.

Community space has the additional benefit of facilitating the network of cooperative farms needed to meet the challenge of a growing food demand. This sentiment was supported 400 years ago by French author Charles Estienne,

who, after a series of advice on siting a farm with regard to wind and sun and the like, concludes by saying “but principally see that it be placed near unto some good and honest neighbor.”¹



Figure 35: Lower Level Plan

The lower level shows additional elements that build the capacity and community resilience. The shop provides a space for local innovation – a place to develop and expand economic viability via fabricated products, self-sufficiency,

and community ownership of open-sourced appropriate technologies.

The ample food storage areas act as a flywheel to store energy in the form of food, offering safety from climate or economic fluctuations. The oversized circulation (lift, stair, truck access, staging areas) create a condition that can easily move hundreds of thousands of pounds of food in and humanure out by pallet and dolly instead of labor. The mechanical room also acts as a flywheel housing hundreds of gallons of water heated by sun and wood to be distributed to various spaces.

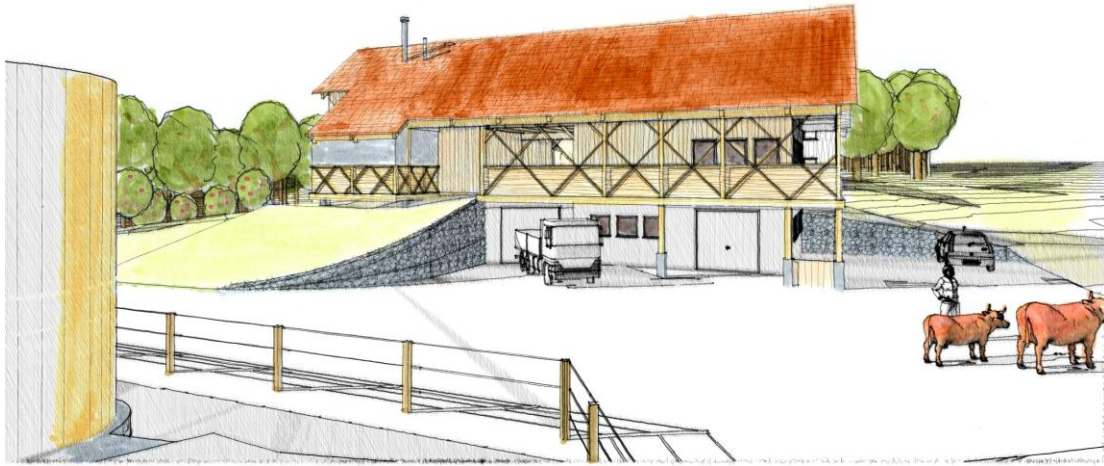


Figure 36: Work Yard (Looking South)

Looking south to the people barn from the raised upper entry of the animal barn we see a number of strategies in place. A truck can easily back into a covered area that provides an extension to the interior spaces beyond. A longer span is achieved by integrating a wooden truss into the deck rail. The deck provides ample space and views for social activity that is physically removed, but visually connected to the farm operations. This view also shows how the structure is bermed into the earth with retaining walls to create access to the

storage, mechanical, and shop space. While maintaining a single roof, the summer kitchen pushes out to the north to take advantage of cooling breezes and summer shade.

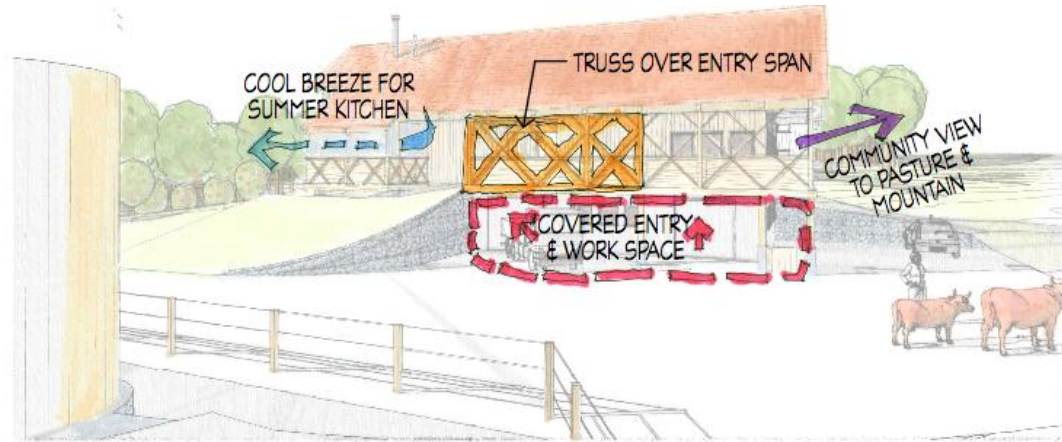


Figure 37: Work Yard (Diagram Overlay)

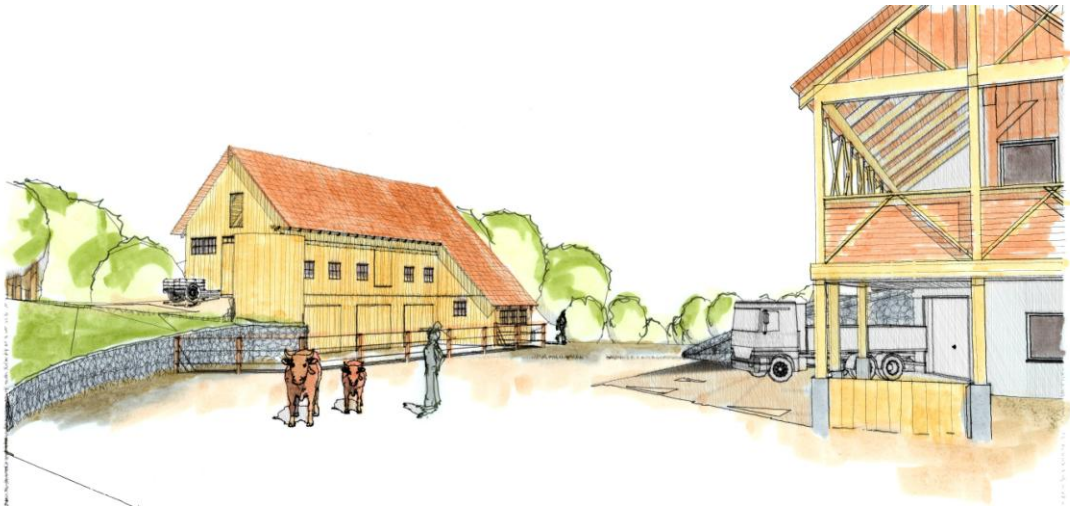


Figure 38: Work Yard (Looking East)

Looking east towards the work yard as the cows saunter back to the fields after a morning milking. The diagram below outlines the seasonal flux in microclimates. (Figure 39) To the south of the yard tucked under the north side of the building is a cool shady space for staging sensitive vegetables or extending

the shop projects to a cool work zone. Tucked into the hillside is an animal winter loafing area. The upper level of the barn absorbs solar energy and breezes to keep fodder dry. The background shows the pedestrian connection between the milk room and kitchen.

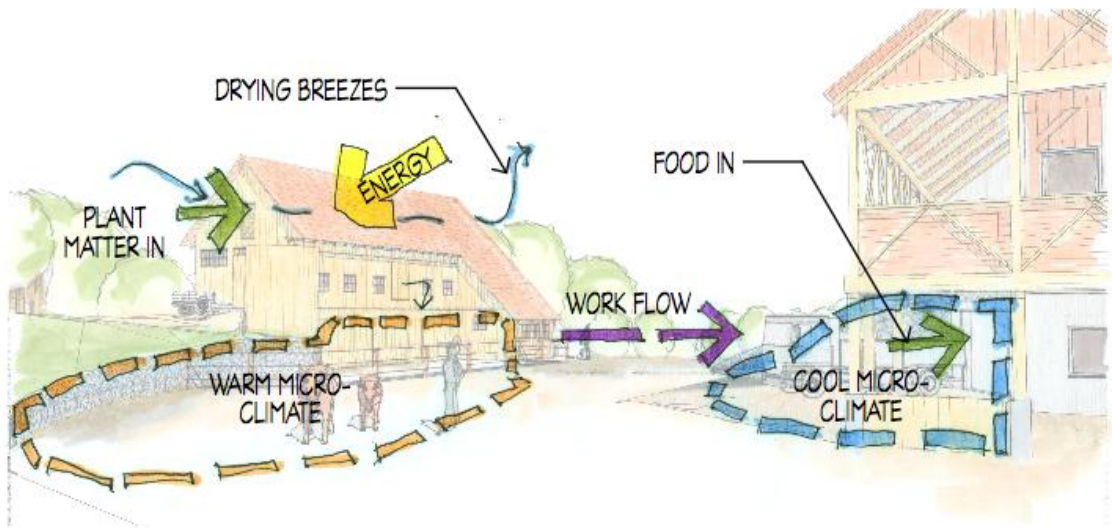


Figure 39: Work Yard (Diagram Overlay)

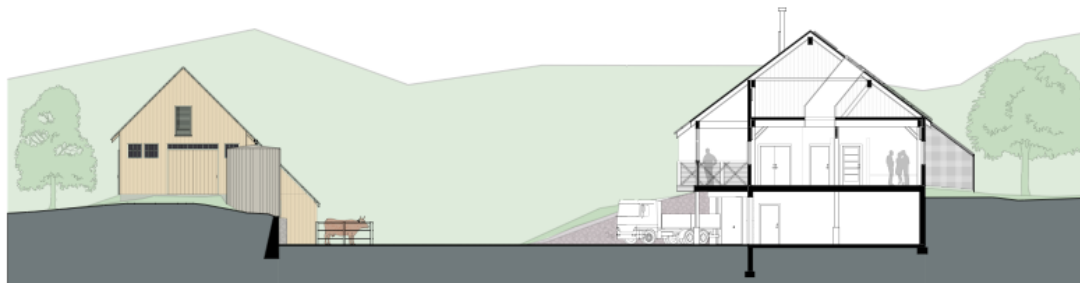


Figure 40: Building Section A (Looking East)

Sections A & B further describe the relationship between the two buildings. Their connection is celebrated as they reach towards each other with arms of wood, stone and earth. The complexity and porosity of the people barn can be seen as it pushes out the greenhouse and summer kitchen, pulls in light through a light well, and encloses porch spaces. The farm sits in a valley that is

echoed by the valley between the two structures.

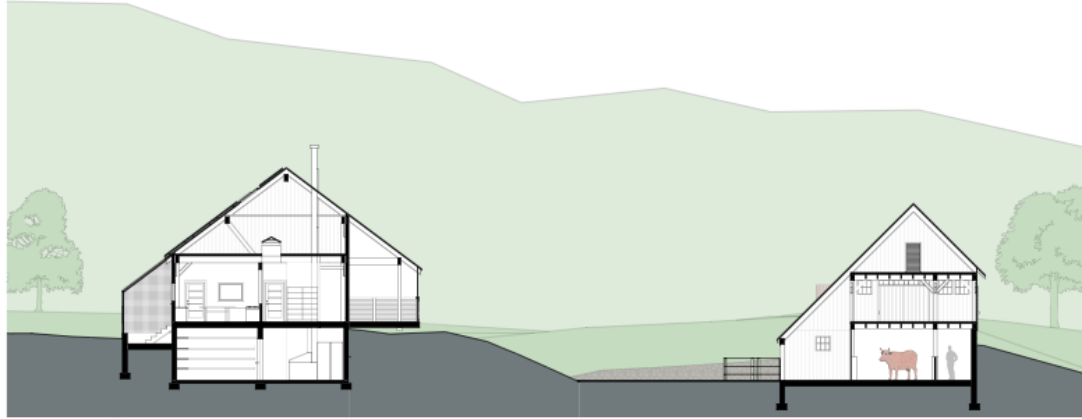


Figure 41: Build Section B (Looking West)

Tectonics

One of the challenges of our current global environmental crisis is the feedback loop. Even though one may intellectually understand global warming and even viscerally relate to the threat, when we emit greenhouse gases (driving, heating, typing on this computer), there is a long delay before the effect is revealed. It is the same for resource consumption in a global marketplace. Vernacular culture (including its built manifestations) has a resource base limited to their locality. The result is a self-limiting system. One goal of this design is to create buildings that emulate the traditional self-limiting system. This drives strategies of simple buildings of wood and stone, material choices that can be replaced and repaired with regional resources and skills. The use of local craft also has the potential to generate elegant forms.



Figure 42: Sectional Rendering

Wood is used as solid timber joined in the traditional manner (limited to 15' spans), open trusses for both aesthetics and larger spans, and simple wood framing for infill and expanded envelopes. Wood is easy to manipulate and dismantle. Investment in the structure is paramount as it will outlast the skin of the building almost indefinitely. Stone is used for retaining walls and as large aggregate in slip form concrete foundation walls.

While the animal barn is a simple bent system, the people barn is a hybrid system based on a series of longitudinal bents of varied height and an asymmetric canted queen post with principal purlins. This allows for a mid-span support of the rafters to the south with the purlin; and to the north with a taller exterior wall bent. The northern roof eave (covering the summer kitchen and porch) is supported by a continuous spliced beam. This system allows for a simple roof form covering the more complex arrangement of spaces without sacrificing flexibility.

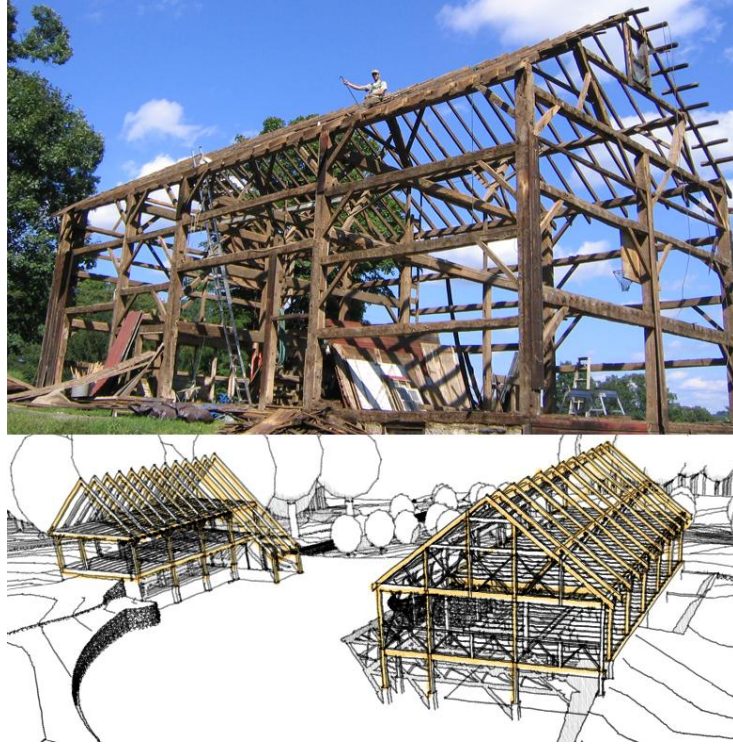


Figure 43: Traditional 5 Bent / 4 Bay Frame Over Designed Frames



Figure 44: Canted Queen Post & Principle Purlin

Systems

The delicate balance of any system is optimizing resilience with efficiency. Though related, they are slightly different. An efficient system may require many moving parts and can rely on technology that cannot be replicated on-site--such as microchips, precision parts, or rare materials. Conversely, a resilient system may be durable and simple but, lacking sophisticated controls, operates at a lower level of efficiency. Occasionally it makes sense to create a passive back-up that is less than optimal but more likely to work in wake of unplanned events that disable the more fragile active system.

Typical human habitation in this climate requires energy for heating, hot-water, plug loads, and transportation. Food handling adds machinery, heat and cooling for processing, and storage space conditioning. Below is an energy management schematic for the farm center.

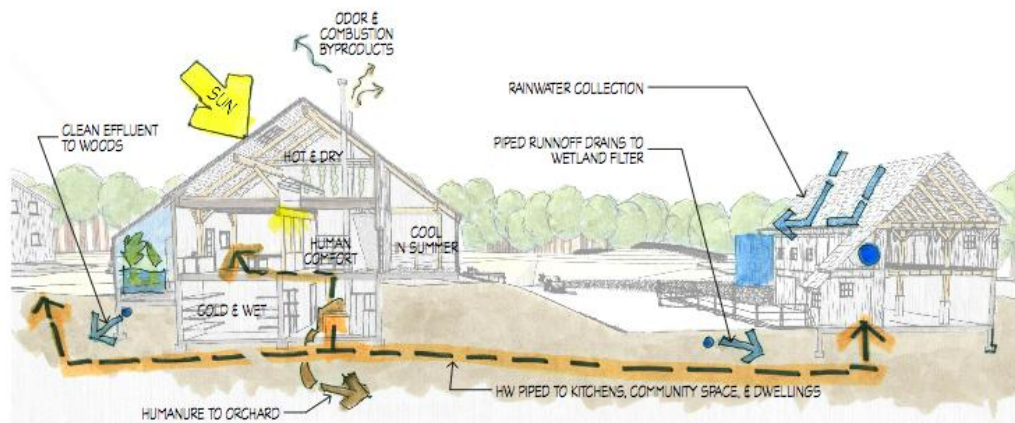


Figure 45: System Overlay

The following strategies are employed for building systems:

- Wood boiler and solar hot water system housed in central location with underground hydronic delivery to additional buildings.
- Zoned heating and plumbing to allow for fluctuating daily and seasonal usage patterns.
- Interior climate zones situated to their conditioning requirements – Root cellars: cold, dark, and wet in the basement connected to the moist 50 degree earth; Drying Rooms: hot, breezy and dry in the attic connected to solar radiation and wind flows. Both are connected to the kitchen for easy access.
- Passive solar UV sanitizer and drying racks.
- Super insulated only where needed. Insulated with cellulose, which can be manipulated and added to with various materials such as woodchips, wool, etc.
- Slip form concrete wall exposed between greenhouse and kitchen act as thermal mass.
- Appliances: A variety of high and low tech to optimize efficiency and resilience.

Additional Patterns, Principles, & Strategies

Below is a summary of additional design considerations that were applied to this project.

Design for Change: Based on the assumption that our society will experience, by our standards, drastic change, it makes logical sense to prepare for that change. On a micro level, that means creating infrastructure that is flexible. On a macro level that means creating cultural and economic structures and customs that are open to a world without cheap oil.

Design for Generations: Years ago, before he was famous (or as famous as a farmer can be), Joel Salatin wrote a fantastic article and later book on maintaining the family farm. His basic premise was twofold. One, allow the members of the family to pursue farming ventures of their own. Two, do not make an investment that would preclude premise one. For example, as soon as a farmer invests half a million dollars into a state-of-the-art cow dairy, then whomever farms that farm is beholden to that debt with a system that does one thing--milk cows. Thus, if the offspring are not interested in milking cows (a very common disinterest), that farm is likely doomed to foreclosure. On the other hand, if one sets up a system that facilitates diverse interests and farming endeavors, the farm has a greater ability to retain family members.

Design For Land, user and future user: Early in the planning process, it is necessary to estimate the carrying capacity of the land. How much and what production can the land support without decreasing that capacity and ideally increasing it? This limiting factor is then coupled with the human entity(s) that will engage the land. What is their aptitude, passion, resources, interests, etc., paying attention to the needs and desires of future users as well.

Design a connection to the community: The basic concept here is to create specific ways for a farm to integrate into its local community. While a farm can cater a connection to external markets, such as a food processor two states away, it will always be located in its own community. Additionally, a farm is

unlikely to have control over global economic trends that dictate the activities of large processors. Therefore, fostering a positive connection to something that rarely changes--location, creates an inherent stability.

This can be true for other businesses as well--especially those based on a specific resource--such as a lumber mill and its associated forest or production facilities that rely on regional crops. However, this condition is especially pronounced for the farm--an endeavor based on its own ostensibly immovable soil.

Community connection can take many forms: cultural, logistical, educational, economic. Economic models such as the CSA farm, farmers markets, farmstand, or other local markets are financially wedded to their community. Success is mutually beneficial.

The infrastructure of community connection could be a store, public gathering space, recreational space, or CSA pickup area. Other ways to design this connection are to create critical infrastructure such as community-scaled food storage, or to invite the public to participate in practice runs of labor-intensive farming such as harvesting grains without a tractor. Even if tractors are the norm today, building a way to replace them with human labor can engage and strengthen the farms connection to community. The coordinated effort of farming without cheap energy will require great practice.

All of these improvements have an enhanced potential to integrate the community if they are made safe and accessible.

Regional Sufficiency & Self Sufficiency: This follows from the notion that regional or local resilience is necessary for individual resilience and that resilience (“the ability of a system, from individual people to whole economies to hold together and maintain their ability to function in the face of change and shocks from the outside.”¹) is necessary for survival and sufficiency. Rather than trying to have every farm enterprise generate every product without any inputs, we can implement systems that recognize a diversity of farms and related endeavors as well as diversity within a farm. Ideally, farms are able to minimize inputs based on fragile, global, and capital intensive systems. However, as different agricultural activities are suited for different landscapes, a network of interdependence can strengthen the overall system. For example, a small vegetable operation in a densely populated area cannot afford the land-base required to feed animals year-round and a larger farm in an area with lower land prices has less access to markets. By inputting animal feed from the larger farm of field crops to the small farm or row crops, the smaller farm is adding fertility through feed that is distributed by animal manure. They are not self-sufficient, but regionally sufficient and will not need to input corporate fertilizer. Both farms benefit by filling a niche. Connections can also be developed with symbiotic industries such as: abattoirs, smoke house, or other value added producers.

Judicious Use of Fuel: This concept is based on the assumption that fuel, as we know it (cheap & abundant), has a limited future. Therefore, use it to create systems that do not require it rather than those that do. On site, this takes the

form of earthworks, land clearing, keyline plowing, etc. instead of long rows of mono-crops that require repeated tractor passes to grow. While tractors are currently a very useful way to produce food, a farm that cannot produce food without them is vulnerable to fuel accessibility fluctuations. Similarly, by this thinking, it would not make sense to design an animal barn that requires a machine to feed the animals or be kept clean, ventilated, etc.

Understand Growth especially as it pertains to efficiency. etc. One key concept is that increases in growth must be accompanied by equal increases in decay.¹ This is relatively easy to manage at a single farm scale. However, in the larger system of our society, growth has increasingly out-paced decay since the agricultural revolution. The pattern has been expanded upon by Architect Phil Henshaw, who has shown that despite vast increases in efficiency, that rate of consumption has increased exponentially. This was predicted accurately as well by William Stanley Jevons in 1865. The Jevons Paradox showed that the more efficient coal technologies became, the quicker the UK would deplete its coal reserves.

Don't buy it if the neighbor has it; and expect the same of them. While redundancy can be an excellent safety net, it may also be a net loss of dollars/debt to external corporations. Interdependence can save farms money and create community. This concept values cooperation and the local system over the competition, which had led to the get big or get bought, approach.

Creating a local food system will have a positive effect on economies and communities. In Bill Mckibben's book, *Deep Economy*. "3/4 of Americans confess that they don't know their next door neighbors. That's a novel condition for primates; it will take a while to repair those networks."¹ Borrowing works well with high capacity-low utilization items such as a backhoe. They are expensive, but don't require daily usage or a seasonal crunch such as harvesting equipment. This concept can work well with smaller tools or even labor and markets as production and consumption fluctuate.

Creative Ownership Structures: Within a society based on personal ownership, the ability to make a long-term commitment to land can be limited by the ability to secure long-term control over land. Especially in areas where land prices are high, the potential for a farmer to sustain high debt from a small farm is very difficult. There are many ways to farm without owning the land that can create security for the farm investments.

Community Ownership – For example, a non-profit land trust buys farmland with community support and leases it to the farmers. The farmers own the business and infrastructure, which gives them equity in the investment. Similar long-term leases with landowners work as well.

Consumer ownership models also create the potential to circumvent laws that claim to protect public well-being, but often increase the pressure for larger farms. A common example is the highly regulated milk and meat industries. The basic premise is to give consumers an ownership share in the operation, thus

making the farm and consumer one entity absolved from laws that apply to the sale of these products.

Marketing Matrix: Consider and understand how farm products will be exchanged for other goods, services, or currency. The way in which product is sold effects the way it is produced and handled. Similarly, different models work better with different landscapes, markets, and farmer personalities.

Below is the result of a brainstorming session of new farmers to determine some of the pros and cons of various marketing strategies.

Marketing	pros	cons	infrastructure	other
Farm Market	local community, high prices, connect to consumer, talk to other vendors	selling, time to prep, off farm, extra waste, weather, packaging, time commitment, only lasts a few hours	truck, booth	low volume: customer ratio
Agritourism, Education, B&B	Grant access, far away market, serving all, money maker?	zoning, public private interface, liability, service oriented	experience, like a production, housing, kitchen, could be big,	Very Important mission, expectations, marketing efforts, clear presentations and expectations, vs. product purchase, bigger commitment in customers life
Pick Your Own, Farm stand	no staff, easy upsell value added	privacy, access, zoning,	shed,	unplanned shopping, location accessibility, impulse, higher aesthetic standards to attract customers
Farm store	on farm, legal plusses, big diversity easily, coop of other farmers	privacy, staff, staff time, access, stocking and waste, zoning	building, lights, cooler, staff, cash register.	location and accessibility, higher aesthetic standards to attract customers
CSA	help from membership, pre pay, lower risk, higher return, community, less at the mercy of buying habits, transition model,	visits from too many folks, responsible to membership,	stuff for cities vs farm	look good aesthetics, manage expectations
Internet	communication is easier, virtual connections to many farms/customers easily,	disconnect,	web manager	group buying, fees for being in coop, doesn't need to look good,
Wholesale, Restaurant, Coops, Grocery, Distributors	professional relationship, constant demand, overflow, quality of the relationships, loyalty, can help with outreach and building brand, asshole friendly	possible rejections, finicky, price is the most important, hagglng,	shipping boxes, waxed, larger facility for processing, QC higher, truck, driveway, and turnaround, loading dock,	volume because lower price, doesn't have to look good,
Barter	yes!!!	vague, bitter,	beads and pelts	culture
Services	consulting, equipment sharing,			hay mowing, slaughter, barn raising,

Figure 46: Marketing Matrix

Annual Work Cycle: The typical farm pattern is to work long hours in the summer and few in the winter. While this mimics the natural cycle, it can be over-taxing in the growing season. With the right infrastructure, a farmer can spread her workload throughout the entire year. This facilitates a stable cash flow and ability to keep good employees year-round and thus long-term. One way to do

this is with heated greenhouses. This allows a farm to generate a product year-round and especially in the winter when the price for greens goes up. The higher price allows the farmer to scale back in the summer and to create a manageable 40 hr/week lifestyle year round.

Employ wise Redundancy: Especially where there are complex systems that relate to large investments. In the example of the root cellar, fall cooling can be optimized by employing thermostatically-driven active mechanical ventilation. This ensures the proper conditions for storage. The price and complexity of the system are proportionally scaled to the value of the food being stored. A hundred thousand dollars worth of storage crops deserve a system that will maintain consistent temperature and humidity. However, if that system is dependent on electricity, many moving parts, or complex electronics, it is vulnerable to failure. Creating layers of redundancy can mitigate this risk. Design the mechanical system such that it can be easily converted to a passive system. Consider ways to generate and store electricity on site. This is similar to the notion of being safe to fail rather than failsafe.

Design for Climate Change: Employ techniques that allow a farm to handle extreme weather fluctuations.

Flood/drought – create buffers with ponds and keyline design to prevent erosion and keep large storm even water on site.

Unpredictable harvest – Plant a greater diversity to mitigate blight, pests, hail, etc. effects. Store more to handle fluxuations in expected harvest.

Heat stress – ventilate, shade, and provide plenty of water for animals.

E uncertainty – Improve conservation and productive capacity.

Waste = Excess: Everything has a use; it only becomes waste when it is in excess, such as city sewage or mega-dairy manure lagoons. Finding a home for the excess can turn it into useful nutrients.

Grow Food Everywhere – As the need for food increases we will need to learn to grow it in marginal circumstances while improving those circumstances.

Sacrifice zones: This pattern applies particularly to animal handling. When confined to a certain area or if there is repeated traffic in that area animals will trample and decrease the productive capacity of that area. It is inevitable that this will happen to some degree. However, the goal is to harvest as much sunlight as possible. Therefore, careful placement of animal housing, lanes, doors, etc. can mean the difference of as much as a few acres.

Single level facility: A medium sized vegetable farm could potentially be handling ½ a million pounds of produce per year. Moving that much weight around by hand is a tremendous amount of work. By creating a facility that is predominately on one level and with smooth floors allows virtually all produce handling from harvest to sale to be done with wheels. A combination of carts,

wagons, trucks, pallets and pallet dollies, etc. saves many hours of labor and is less taxing on the back.

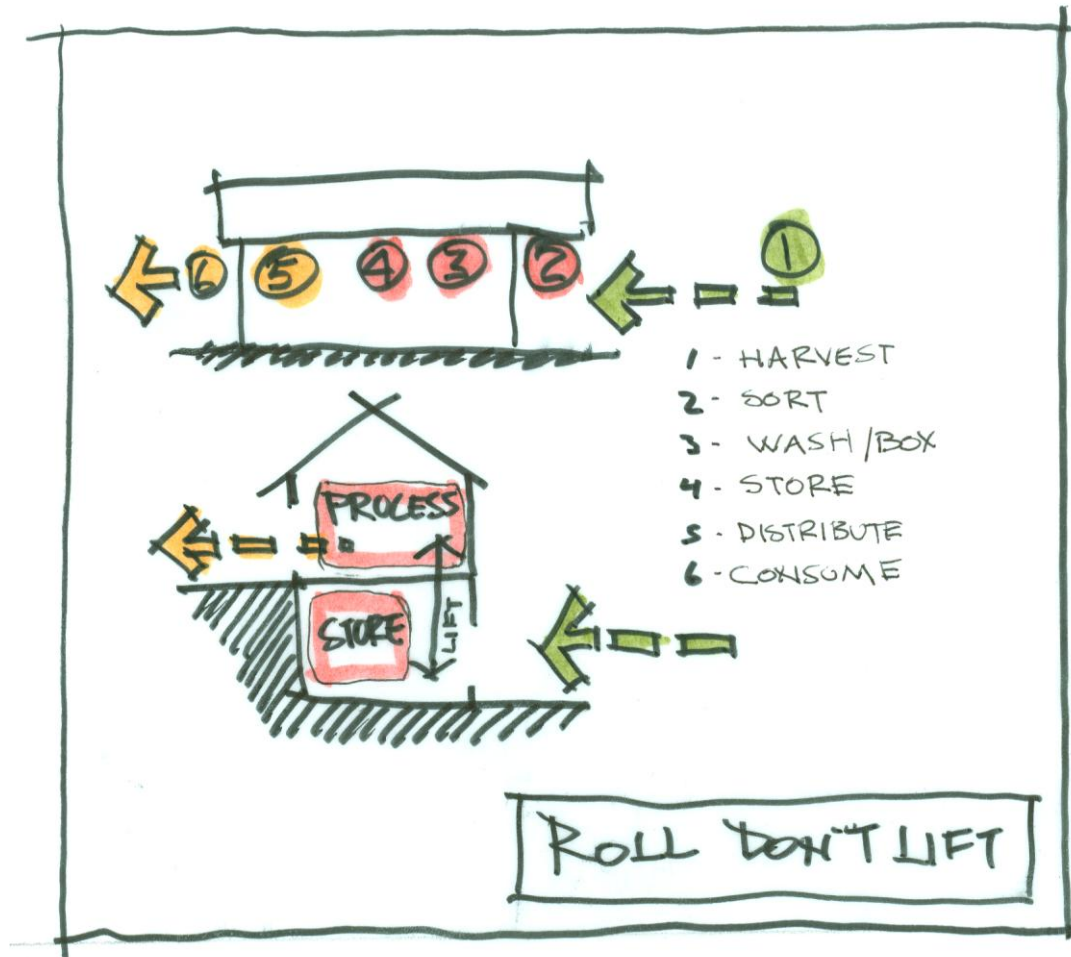


Figure 47: Single Level Facility Sketch

Storage Hierarchy: Because of the many tools, implements, soil amendments, boxes, etc. required to run a farm, storage is at a premium. Insufficient storage leads to weather exposed and damaged equipment, and increased labor needed for frequently moving one thing to get to another. Additional problems come when something is not accessible when needed because it is lost to an unorganized system or cannot be accessed without the help of another.

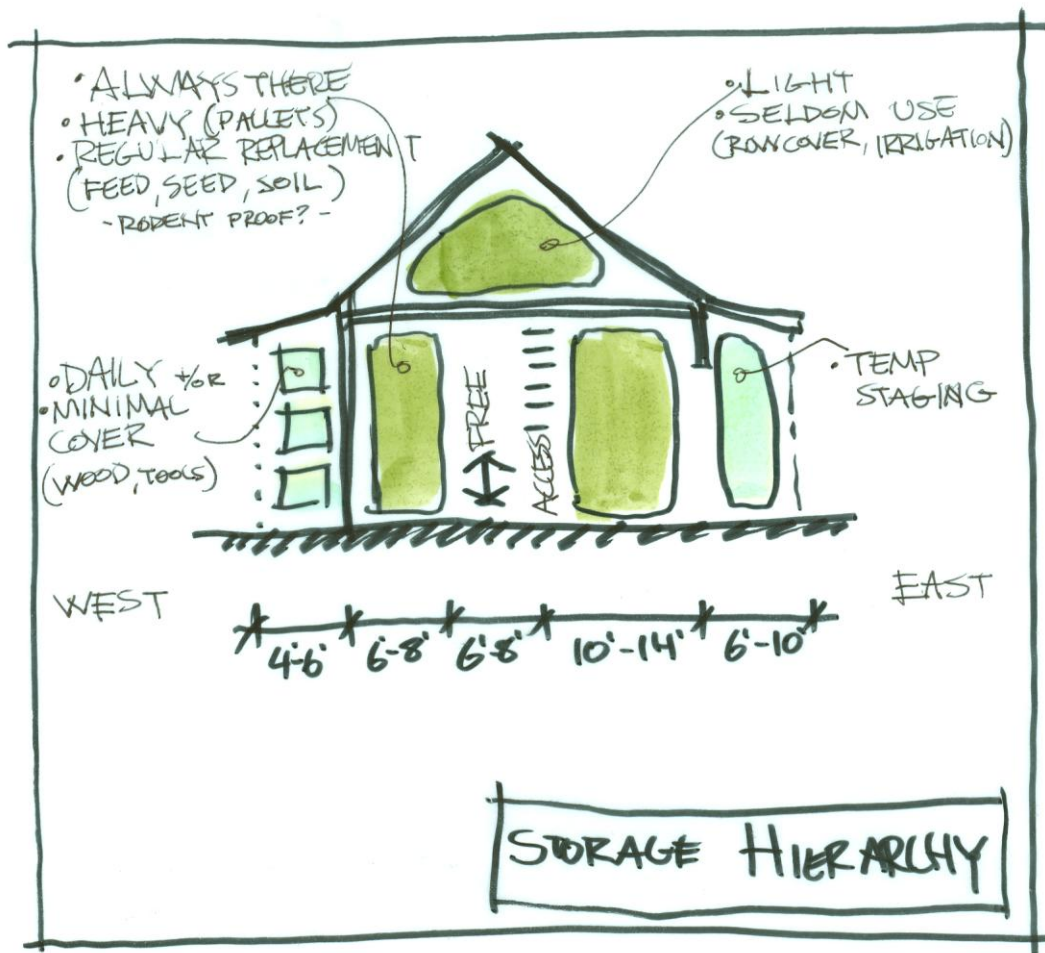


Figure 48: Storage Hierarchy Sketch

An effective storage system makes clever use of protected spaces and matches storage requirements to storage conditions. In order to maximize space in this way, items also need to be categorized by usage. For example, a vegetable grower may have irrigation lines that come out in the spring and are put away in the fall and require being out of the sun for storage. Most plastics also last long if not exposed to wide temperature extremes. Thus, irrigation can be stored in a space that is relatively difficult to access, blocked by other season items, such as

row cover, etc. On the design end, this means creating access and structural reinforcement for spaces as within rafters/collar ties or truss sections.

Forethought can lead to some very sophisticated storage patterns. Harvest containers, especially those made from wood, can be susceptible to mold if allowed to be wet for prolonged periods. A well-placed rack under the large eave of a west facing wall and adjacent to the washing, packing, sorting area can provide an excellent summer storage rack for harvest boxes that uses the UV rays of the sun to dry the containers.

Animal Preferences are many and often unique to individual animals, herds, breeds, or species. Good observation can lead to good decisions in the regard. Below are a few rules of thumb that can be a good starting point. Cows prefer to walk up hill, towards light. Round holding pens will prevent stock from stopping in a corner. When being herded, sheep move to the place of least resistance and will puddle there even if it is a dead end. Goats will walk over bridges, through tunnels, etc. while cows may balk at a change in color on the ground or barn floor.

Adaptable Structures can be designed not only for future expansion but for contraction. All farms experience transition. Production can require scaling back for economic, personal, other circumstances. Designs that can only operate at one capacity are vulnerable to being inoperable.

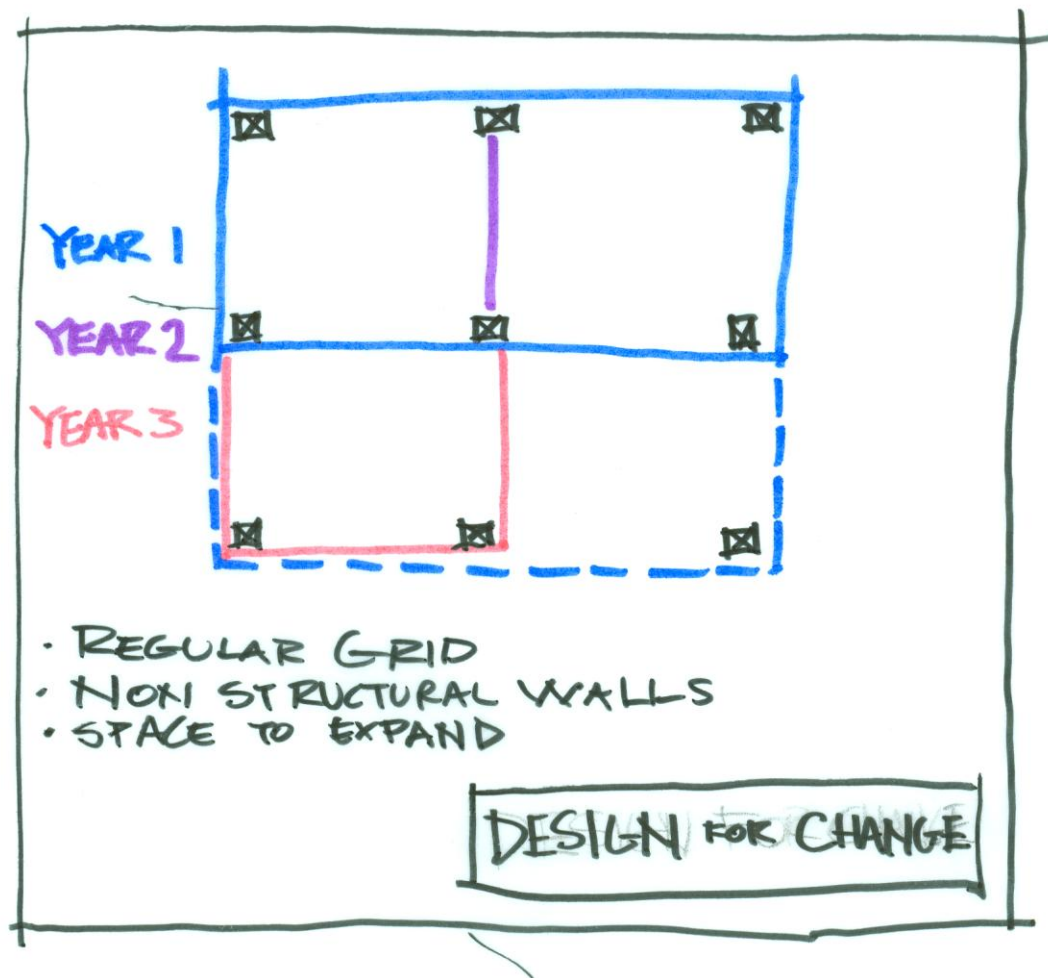


Figure 49: Design For Change Sketch

Roofs and Doors present a fantastic puzzle regarding the management of water and snow. Consider doors by their size, frequency of use, type of use, and relation to eaves. Large doors that require being opened in the winter will benefit from being sliders if they are under an eave. Locating this type of door at a gabled end will improve access by eliminating the snow bank formed by roof snow. Small doors that only require people entering empty handed can be made

very narrow. As we saw with the Mesakin hut, doors can reflect a very specific use.

Regularize Field and Fencing Layout: This pattern looks at one system for optimizing vegetable fields. Cultivate only as much land as you will effectively utilize. This allows a more precise, efficient, and flexible system of field applications such as soil amendments, irrigation lines, planning, pre-cut row cover, seeding rates, work time, etc. The basic concept is to create regular repeating shapes with the context of irregular fields. Irregular spaces left behind can be grazed or planted with species that do not require rows.

Create Cores: Certain spaces carry high premiums both in cost and complexity. Conditioned spaces (offices, housing, food storage) require temperature control by reducing loads and employing mechanical systems. Processing facilities require hot water, draining concrete floors, etc. Spreading these uses apart, while occasionally necessary due to other programmatic constraints, can be costly and inefficient. Therefore, cluster similar uses together in order to reduce cost and energy consumption. (See Program Diagrams)

Compostable and Dismantlable Buildings: Typical thinking dictates that we make buildings as durable as possible. However, a small shed may only have a lifespan of five to twenty years. Sometimes structures are built that may be outgrown or prove to be in the wrong location, etc. For these buildings,

techniques of durability such as foundations, paint, etc., can make razing difficult. A building framed and sheathed in wood and put together with careful use of fasteners can essentially be composted at the end of its life. The worst-case scenario building is one that is neither durable nor non-toxic.

Notes

¹ Rob Hopkins, *The Transition Handbook: From Oil Dependency to Local Resilience* (Totnes: Green Books Ltd, 2008), 12.

CHAPTER 4

CONCLUSION

The essence of farming is collecting solar energy and then storing that energy in a form of food suitable for humans. Beginning with photosynthesis, food-energy can travel many paths before we consume it. Once expanded this linear relationship becomes a complex series of interactions – like any eco-system. To understand these interactions we must examine them closely. To learn how to effectively harness these interactions in a sustainable and regenerative manner is paramount to our survival.

Looking specifically at the current design process for farms, the conventional/corporate industrial mode of design is based on an intelligence that is outside of the system of production, with profit goals that are external to the health of a system. Through economic pressure on universities and extension services, lobbying, advertising and domination of agricultural equipment sales, corporations are redesigning farms to be mechanically, chemically, fossil fuel, and corporate dependant.

The analysis of food production raises many questions. What would it look like to put the design intelligence back inside the system? Can we design so that the designer is within the feedback loop? When a structure is created by, for, within, and limited to the materials of a local system what are the positive outcomes? What are the drawbacks? Where does the nutrient base come from? Where does it go? How much energy is wasted? Are the conditions suitable or, better yet, desirable for humans? The farmscape sees constant motion. How can

it be analyzed for maximum efficiency without sacrificing resilience? What are the metrics by which we can judge effective, responsible food production? How does policy affect the infrastructure of food production? What environment is best suited to achieve the desired results. Ideally, it is a system of food production that facilitates the continuous re-evaluation of itself and the questions above.

The built environment has changed since the first small huts that housed a single family, its livestock, and some stored food. The world we have created is so vast that we have now permanently changed the Earth's climate and ecology. At the forefront of that change is the developed world and those of us who have assumed the power to create change. However, our basic needs have not changed. The challenge, as I see it, is to keep our basic needs in sight, without regression, as we move forward into the future we have begun to create.

APPENDICES

APPENDIX A

RESEARCH METHODS

Discovering the farmscape with primary sources . . .

Interviews: Over the years I have developed a relationship with many farms across the Northeast. Beyond looking at the built environment of these farms, I have interviewed the people interacting with them--laborers, farmers, consumers. These individuals are an important key to the best design decisions for successful food production. "Who will do the work?" is a question that needs to be asked along the way. It has been frequently argued that the environmental challenges and potential disasters we face are not due to a lack of technology, knowledge, or the ability to implement best practices, but rather to the inability of our society to change. Can we design to make a transition into sustainable/regenerative production attractive to society?

Farm Criteria: Because food production environments exist all over the world, I have created a set of criteria in order to take meaningful focus on one region. Initially, I looked at a number of farms and agricultural systems within the reduced scope to gather general data on the topic. The primary criteria was the following:

Similar Biome: Beginning with the UNESCO definition of biomes, or similar ecological regions, I will limit this research to the temperate forests biome which

“occur[s] in eastern North America, northeastern Asia, and western and central Europe. Well-defined seasons with a distinct winter characterize this forest biome. Moderate climate and a growing season of 140-200 days during 4-6 frost-free months distinguish temperate forests. Temperature varies from -30° C to 30° C. Precipitation (75-150 cm) is distributed evenly throughout the year.”

Temperate forests regions, although few are still intact, have been displaced by the world’s greatest consumers of resources--the Northeastern US and Western Europe. This makes these regions perfect candidates for an ecological redesign of food production.

Non-Unique Enterprises: In order to maintain relevance and replicable results, I will limit my study to food production environments that exist in some form in more than one place. Farms must relate historically, physically, culturally, or in product to a significant number of other farms.

Regional Scale: Although I may examine global industrial farming for general information and a point of comparison, I have limited my final case study to farms that serve their own regions.

Food Production: This study is limited to environments whose primary function is food production. Fiber, wood, etc. may be secondary functions, but food must be primary. I also looked at food distribution only as it relates to the production end. E.g. I did not look at the vast enterprise of the American supermarket. Below

is a list of farms and food facilities visited. This list is designed to serve as a bibliography of the resource of farms.

- Essex Farm – Year-round 4 food group CSA – low tech; Essex, NY
- Cedar Hill Farm – Small dairy associated with Cobb Hill Community and Sustainability Institute; VT
- Brook Farm Project – Research integrated CSA; New Paltz, NY
- 4 Winds Farm – Organic meat/vegetable high tech/low tech integrated vegetable barn complex; New Paltz, NY



Figure 50: 4-Winds Barn, Greenhouse, Rootcellars, Drying Loft, & Processing Facility

- Hawthorn Valley Farm – Biodynamic Farm, Dairy, Creamery, & Store; Ghent, NY
- Center for Agricultural Economy – Hardwick Vermont
- Harvard Grange – Community Kitchen
- Franklin County CDC – Commercial Kitchen and Food Entrepreneur Incubator; Greenfield, MA

- Green Mountain Girls Farm – 4 food groups, free choice CSA, visitor and event space.



Figure 51: Green Mountain Girls Barn

- Ben Falk's Permaculture Demonstration Farm – Growing food on the wet eroded slopes of New England; Waitsfield, VT



Figure 52: Permaculture Design Office and Aquaculture Pond

- Town Farm – In town walkable CSA; Northampton, MA
- Montview Farm – People-powered CSA, Forest Garden, community education facility; Northampton, MA
- Mountain View Farm – Vegetable CSA; Easthampton, MA
- Simple Gifts Farm – CSA, meat, eggs, vegetables, utilizing land own and protected by North Amherst Community Farm Trust; North Amherst, MA
- Riverland Farm – Vegetable CSA with a solar powered electric tractor; Sunderland, MA



Figure 53: CSA Distribution Barn with Solar Awning

- Vermont Compost Company –Growing soil and Eggs; Montpelier, VT



Figure 54: Vermont Compost Company Soil Barn

- Brookfield Farm – 4 food group CSA with a barn facility that integrates vegetable production, food distribution and community.
- Scores of other innovation and progressive farms around the world.

APPENDIX B

CASE STUDIES

The following pages show a sampling of some exemplary farms from the Northeast. They were picked for both their success as farm enterprises as well as their demonstrated dedication to resilience and sustainability. Additionally, there is formal language that exemplifies the marriage of interesting design and functional duties.

BROOKFIELD FARM CSA BARN

This is a structure designed for a specific task: cleaning, storing, & distributing vegetables to the community. The center of the barn is a large open distribution room flanked by utility spaces. Below is a list of improvements from a farm fundraising letter. The barn is part of the non-profit Biodynamic Farmland Conservation Trust.

www.brookfieldfarm.org



IMPROVEMENTS

- ENLARGED DISTRIBUTION AREA that is energy efficient, rodent-proof, and has adequate lighting
- ROOT CELLAR for year-round distribution of 120,000 lbs of winter vegetables in a way that is energy efficient and sustainable
- CEMENT FLOOR throughout renovated barn to allow us to move 200,000 lbs of produce each year with wheels instead of backs.
- HEATED ON-SITE FARM OFFICE
- SAFER PARKING AND TRUCK LOADING ZONE
- ENLARGED STORAGE SPACE for produce, equipment, supplies, and tool
- WORKSHOP
- COMPOSTING TOILET & HANDWASHING FACILITY
- PHOTOVOLTAIC ELECTRICAL GENERATING SYSTEM

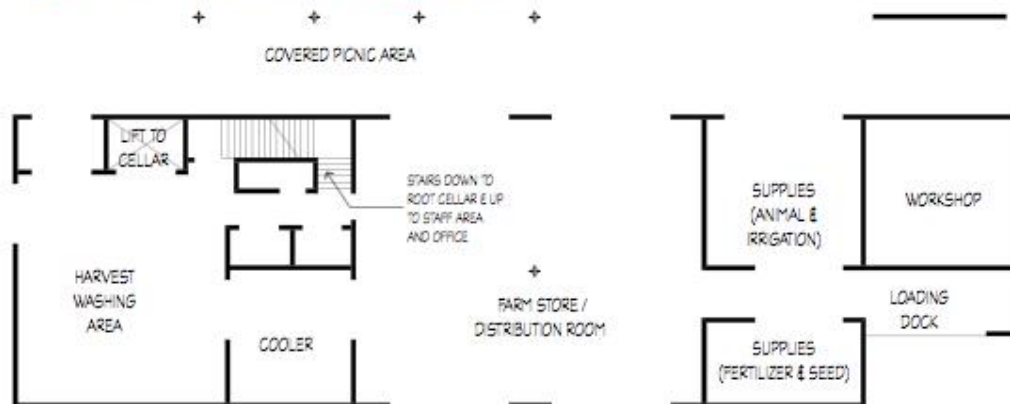


Figure 55: Brookfield Farm Summary Sheet 1



Places to sit and relax



Dumb waiter down to root cellar



Root Cellar - cold and moist



Machinery repair



vegetable drop off



loading dock

Figure 56: Brookfield Farm Summary Sheet 2

SIMPLE GIFTS FARM CSA BARN & MASTER PLAN

An affordable renovation of a single purpose tobacco barn into a multi-purpose CSA barn. The master plan was used both to help plan as well as engage the public in the process. 36 acre farm provides meat, vegetables, and eggs - including winter distributions.

www.simplegiftsfarmcsa.com



IMPROVEMENTS

- Barn renovation - distribution / farm store area, cooler, veggie processing, storage, and machine shop.
- New daylighting to barn interior.
- Major clean-ups and farm appearance up-grades
- Safer parking and truck loading zone
- New farm well and water distribution for irrigation and livestock.
- Stabilization of outbuildings
- Mobile chicken
- Multiple greenhouses heated by waste vegetable oil
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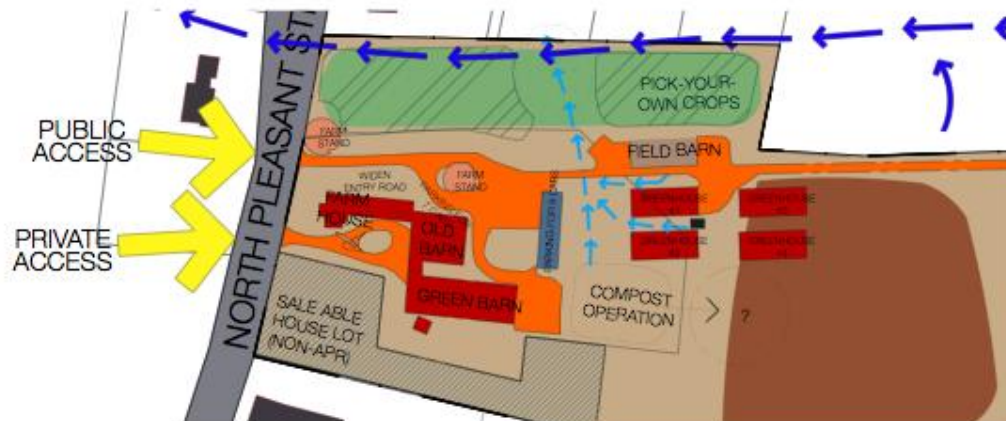


Figure 57: Simple Gifts Farm Summary Sheet 1



Veggie Washing



Winter Eggs



Zoning



Summer Eggs



Residential Proximity



Vegetation

Figure 58: Simple Gifts Farm Summary Sheet 2

TOWN FARM CSA BARN, ANIMAL BARN AND MACHINERY SHED

This farm was developed within the city limits of Northampton, MA making it one of very few pedestrian-friendly farms. They provide vegetables and eggs to members and homestead dairy and meat.



IMPROVEMENTS

- New Farm outbuildings
- Vegetable processing, storage, and distribution
- Shop Space
- Poly-carbonate greenhouse
- Pasture animal milking facilities
- Winter animal housing, hay storage, and milking facilities
- Creative metal reuse
- Water catchment system



Figure 59: Town Farm Summary Sheet 1



Greenhouse



Animal Barn



Chicken Door



Distribution Shed



Machinery Shed



Salvaged metal gate

Figure 60: Town Farm Summary Sheet 2

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